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SEPTEMBER

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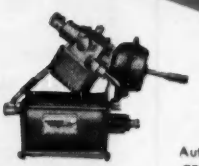
Bendix Products

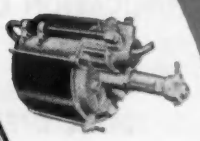
KEEPING BRAKES IN STEP WITH MODERN NEEDS

Centermount Emergency and Parking Brake for Buses and Trucks

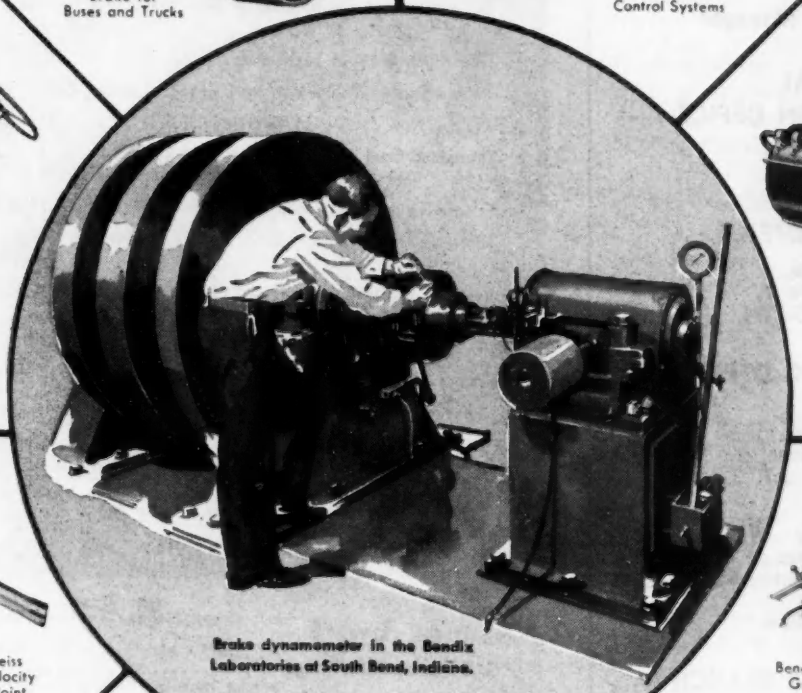


Bendix* Automatic Clutch and Gear Shift Control Systems

Bendix Hydraulic Power Steering Gear

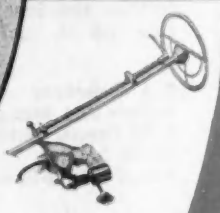


Hydrovac* Power Brake for all types of trucks



Brake dynamometer in the Bendix Laboratories at South Bend, Indiana.

Bendix-Weiss Constant Velocity Universal Joint



Bendix Vacuum Power Gear Shift Assistor

B-K* Power Braking System for Trucks and Trailers

BENDIX* BRAKES

Standard of Safety Wherever Wheels Turn

For over 20 years Bendix research has been making automotive brakes smoother, safer, and easier to operate. For example, in the Bendix Duo-Servo* Brake the friction of one brake shoe "serves" a second shoe against the drum. The result is a remarkably effective brake that needs only a light pedal pressure. This type of creative engineering, plus mass production know-how, has made Bendix Brakes the standard of safety wherever wheels turn.

A new booklet, "Bendix Duo-Servo Brakes", describes this interesting brake principle. Send for your free copy.

*REG. U. S. PAT. OFF.

BENDIX TROPHY RACE SEPTEMBER 6

BENDIX PRODUCTS DIVISION of Bendix AVIATION CORPORATION

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Aircraft

The following men were elected to serve on the Council for 1948-49: F. W. FINK, Chief Engineer, Consolidated Vultee Aircraft Corp.; P. E. HOVGARD, General Manager, Piasecki Helicopter Corp., ELBERT E. HUSTED, President, Titeflex, Inc. Serving on the 1949 Council as Past-Presidents will be R. J. S. PIGOTT, Chief Engineer, Gulf Research and Development Co.; and C. E. FRUDDEN, Consulting Engineer, Tractor Div., Allis-Chalmers Manufacturing Co.

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Chief Engineer, Oliver Corp.

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Vice-President, Operations & Maintenance, Consolidated Freightways, Inc.

Truck & Bus.....**Ernest P. Lamb**
Chief Engineer, Truck Div., Chrysler Corp.

HEAT-

CONVENTIONAL

(This paper will be published in full in SAE Quarterly Transactions.)

CONVENTIONAL heat-treatment is characterized by continuous cooling over the range of temperatures from the austenitizing temperature down through the temperature ranges where austenite transforms to pearlite, bainite, and martensite.

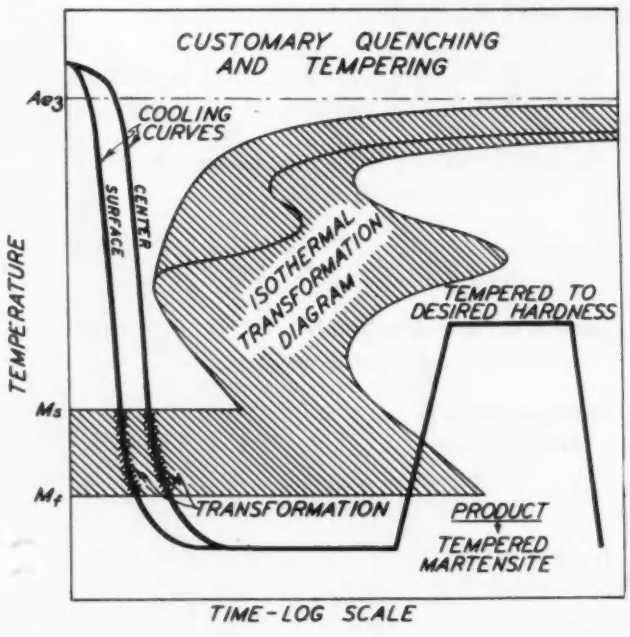
In isothermal heat-treatment, transformation occurs ideally at a single temperature to the precise microstructure desired for a specific set of physical properties.

The concept of isothermal heat-treatment emerged from the coupling of the knowledge of the relationships between microstructure and properties with the recent observation that both the *time* required for transformation of austenite and the *microstructure* of the transformation product are functions of the temperature at which transformation occurs.

This idea can be expressed for a particular steel in an isothermal transformation chart like those shown. The upper left boundary of the shaded area defines the beginning of transformation. The lower right curve defines the end.

Austenite - a homogeneous solid solution of carbon and alloying elements in γ-iron - transforms on cooling into an aggregate α-iron and carbides, whose microstructure and physical properties depend on the transformation temperature. In general, grain becomes finer and hardness and strength increase as transformation temperature decreases. In the 1300-1000F range, austenite transforms to pearlite, a relatively soft and machinable structure. In the 1000F-to-M_s range, the product is bainite, a harder structure, of high ductility at high hardness. Below the M_s temperature (martensite start), austenite transforms almost at once to martensite, hardest and most brittle of the microstructures until tempered.

*Paper "Principles and Applications of Isothermal Heat-Treatment," was presented at SAE Summer Meeting, French Lick, Ind., June 8, 1948.



CONVENTIONAL HARDENING

Quenching and tempering is the process of rapid cooling to the martensite range and subsequent reheating to the desired combination of strength and ductility. Properly carried out, the process permits attainment of the optimum in strength and ductility.

But the product may show microcracks, or even gross cracks, and distortion, due to the high stresses set up during rapid cooling and the large cross-sectional temperature gradient, which causes transformation to occur at different times in different portions.

T-TREATMENT: and ISOTHERMAL

BASED ON PAPER* BY
J. M. Hodge
Research Associate
Carnegie-Illinois Steel Corp.

ISOTHERMAL HARDENING

Austempering practically insures freedom from cracks and minimizes distortion. It consists of quenching to a temperature in the lower bainite region, usually in molten salt, and holding at this temperature until transformation is complete. Then the piece is quenched or aircooled to room temperature.

Because the transformation to bainite takes place isothermally at a relatively high temperature, transformation stresses are low and cracks and distortion are minimized.

Further advantage to austempering is that strength and ductility of the transformation product, lower bainite, are comparable to those of tempered martensite.

Austempering requires a steel whose initial-transformation curve in the pearlite and bainite regions is delayed enough that molten-salt-cooling curves do not enter the "knee" of the transformation area.

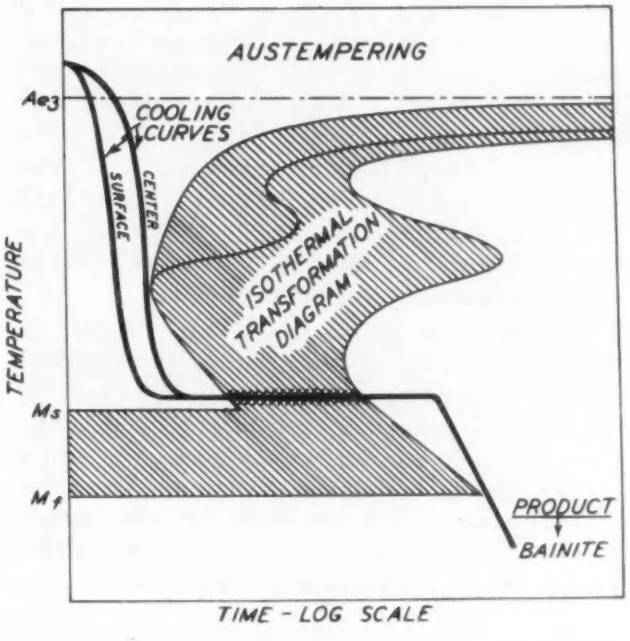
Otherwise the resulting pearlite and upper bainite will lower ductility.

Alloying elements move the "knee" to the right but add to cost. Also they increase the duration of transformation to bainite, making austempering more time-consuming.

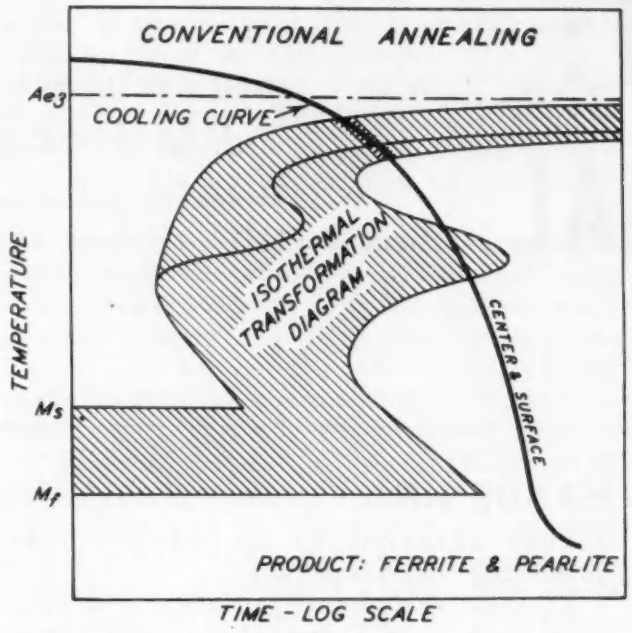
Martempering, although not an isothermal heat-treatment was developed from knowledge of transformation behavior as another low-transformation-stress alternative to conventional quenching and tempering.

It involves quenching into a molten salt bath at a temperature just above the M_S-temperature, holding in the bath until the temperature is equalized throughout the cross-section, then aircooling to room temperature. Transformation to martensite occurs during the relatively slow aircooling, without the temperature gradient present with conventional quenching, and stresses are much lower.

After martempering, the piece may be tempered to the desired strength level.



CONVENTIONAL ANNEALING



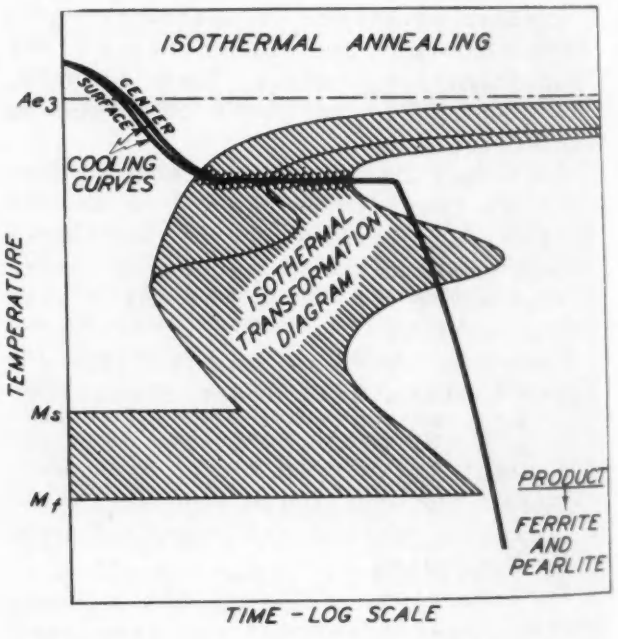
Conventional annealing aims at obtaining coarse pearlite for good machineability in low- and medium-carbon steels by cooling from the austenitizing temperature so slowly that transformation occurs only and completely in the high-temperature portion of the pearlite area.

Full annealing in the conventional manner is a long process because it calls for slow cooling from the austenitizing temperature to a temperature well below that at which transformation is complete.

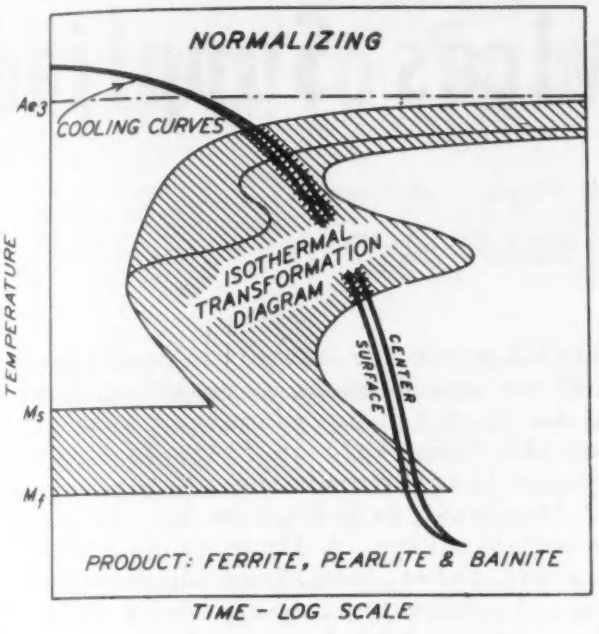
ISOTHERMAL ANNEALING

Isothermal annealing accomplishes the aim of conventional annealing in less time. The piece is cooled rapidly to the transformation temperature corresponding to the desired coarse pearlite structure, held long enough for complete transformation, and cooled rapidly to room temperature. If the extreme softness of coarsest pearlite is not essential, the transformation can be carried out at the knee, where transformation is most rapid.

To obtain good machinability in higher carbon steels, the isothermal annealing process can be modified to produce a spheroidized microstructure. The trick is to austenitize at a relatively low temperature. Then by holding at a temperature in the upper part of the pearlite transformation range, transformation is to spheroidite.



CONVENTIONAL NORMALIZING



Normalizing is practised to refine grain size and to obtain a carbide size and distribution which will redissolve more readily on subsequent austenitization. The conventional method is to aircool from the austenitizing temperature to room temperature.

Resulting microstructure depends on the effect of section size on cooling through the cross-section, but usually there results a mixed microstructure of ferrite, pearlite, upper bainite, and martensite.

Mechanical properties of such mixed microstructures are often very poor, especially if untempered.

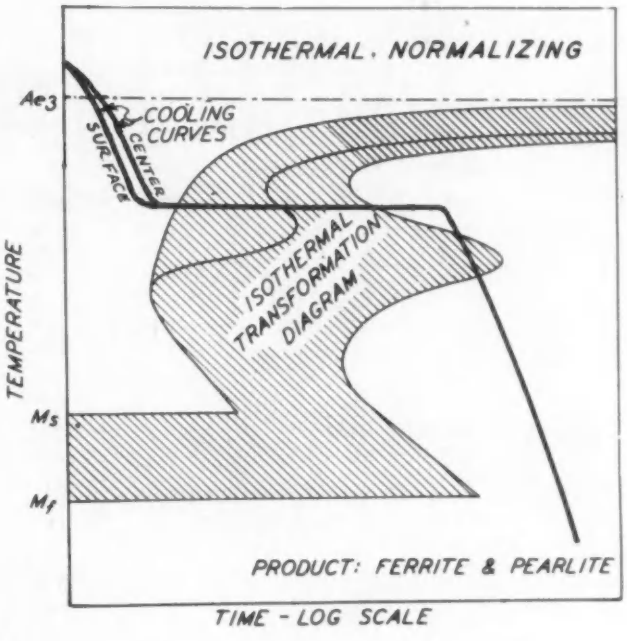
ISOTHERMAL NORMALIZING

Isothermal normalizing transforms austenite to ferrite and fine pearlite - pearlite being, except for bainite, the optimum microstructure for strength plus ductility without tempering.

Isothermal normalizing is similar to isothermal annealing, except that transformation temperature is in the lower pearlite area, (1000-1100 F).

Besides better physical properties, isothermal normalizing gives lower stresses and therefore less distortion than the usual normalizing.

Like the other isothermal treatments, isothermal normalizing has the disadvantage of requiring accelerated cooling rates or alloy additions to prevent transformation above the selected isothermal transformation temperature.



(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

German Devices Supplied

TO enable their submarines to remain under water longer without surfacing, the Germans developed three devices during World War II to supply oxygen for submerged propulsion by submarine diesel engines.

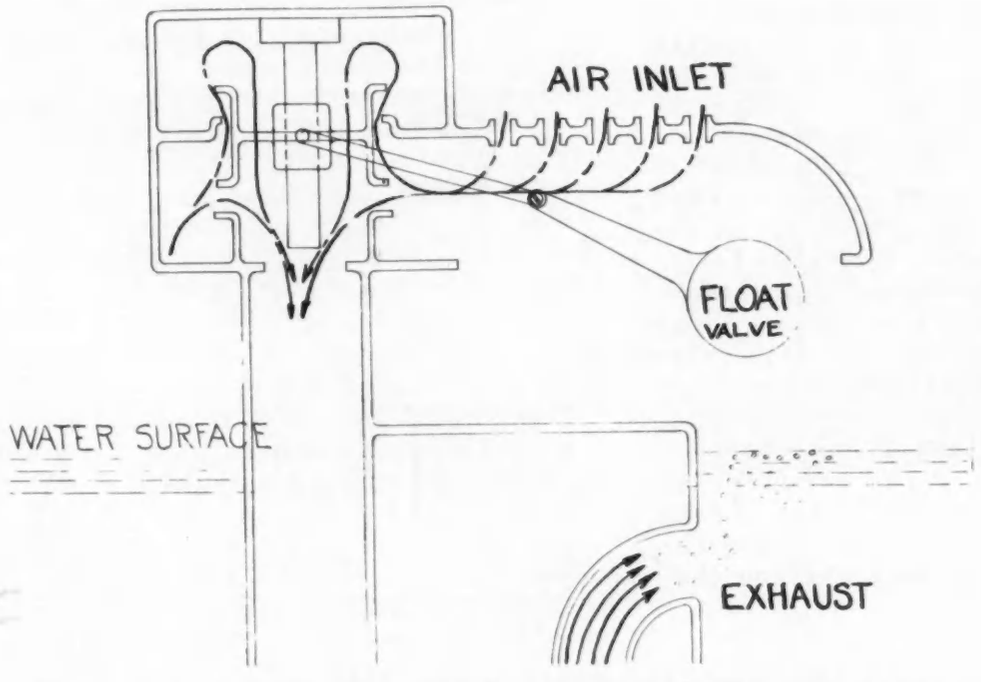
One device piped air from above the surface of the water to the hull and returned to the exhaust. The other two provided oxygen from underwater supplies.

The devices were the German answer to the Allies' radar for detection and multiple depth charge barrages for destruction of submarines. All three circumvented the submarine's need to surface to operate its diesel engines for replenishing the storage batteries which furnish power for submerged operation.

First development permitting diesels to be operated in submerged submarines was the Schnorkel, in 1943. In this system, a float remaining at the surface of the water provided an air inlet and an exhaust line. A float valve protected the air inlet line from shipping seas. Fig. 1 shows how water could lift the float valve, which cut off the air supply. A pipe carried the air supply to the submarine hull.

Adjacent is another pipe which carried diesel exhaust gases from the engine manifold to a muffling device in the float.

For surface propulsion, a long valve



●Fig. 1 - Diagram of Schnorkel float used with German submarines

Oxygen to Submerged Subs

BASED ON PAPER* BY
C. G. A. Rosen
Director of Research
Caterpillar Tractor Co.

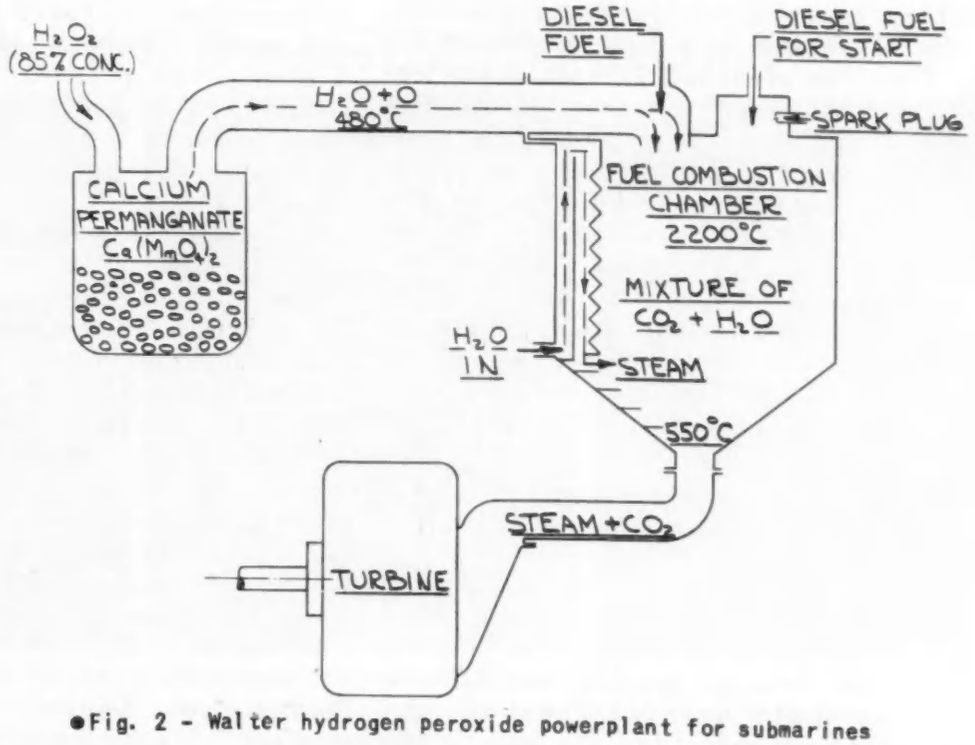
overlap was used on the diesel engines to secure effective performance of the Buchi turbosuperchargers. But under Schnorkel conditions, the valve overlap had to be narrowed to a relatively small angle because of the high back pressure of the long, restricted exhaust line - plus the fact that the float valve sometimes cut off the air supply, leaving the engine to draw its air from the engine room.

The achievement of stable hydrogen peroxide in 85% concentration made possible another device for underwater propulsion. Fig. 2 is a diagram showing how hydrogen peroxide was broken down into water and oxygen; how the oxygen was burned with diesel fuel, forming carbon dioxide; where more water was added in the form of steam; and how the steam and carbon dioxide entered the Walter turbine.

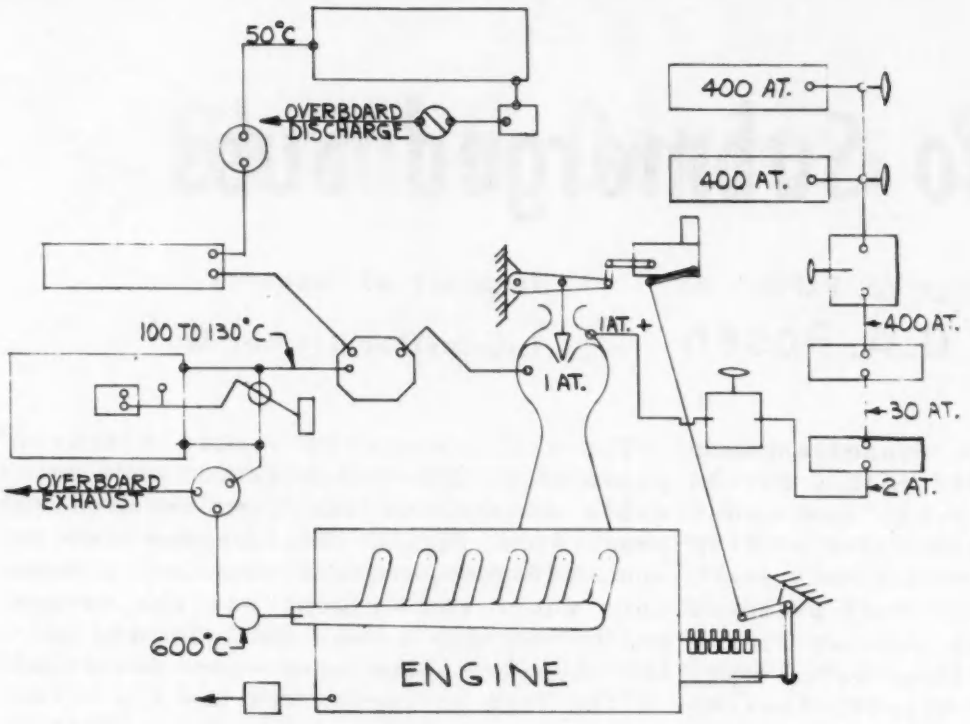
The turbine developed 2500 hp at 10,000 rpm. Exclusive of boiler and auxiliaries, it measured 40 in. in diameter and 54 in. length.

This unit, installed in a hull designed primarily for underwater propulsion, pro-

*Paper "Survey of Possibilities of Diesel Engine," was presented at the SAE Metropolitan Section, New York, Dec. 19, 1946.



●Fig. 2 - Walter hydrogen peroxide powerplant for submarines



●Fig. 3 - Kreislauf powerplant for submarines

vided a submerged speed of 25 knots maximum.

A third system, the so-called Kreislauf system, added oxygen to scrubbed exhaust gases for submerged propulsion. Exhaust gases were cooled in a heat exchanger to an outlet temperature permitting satisfactory cleansing in a gas-scrubbing device. Then the cleansed exhaust gases entered a venturi chamber, becoming a carrier fluid for oxygen injected into the venturi. The mixture of cleansed gases plus oxygen was introduced into the engine cylinders through the normal induction system. A pressure of about 1 atmosphere was maintained to provide compression pressure suitable for autoignition of the fuel introduced in the normal manner through the fuel valves.

EXCESS EXHAUST DISCHARGED

Since the engine was constantly producing more exhaust gas than was needed in the return line, the excess was passed through other heat exchangers and finally pumped overboard by high-pressure gas pumps capable of rejecting the gas to the sea surrounding the submarine even at maximum submerged depths.

Oxygen from either of two supplies could be accommodated. Some liquid oxygen was stored within a section of the hull of the submarine. If the trip required more oxygen, it could be stored in trailers at 400 atmospheres pressure. As Fig. 3 shows, the pressure was reduced gradually through reducing valves to a pressure of about 1 atmosphere at the venturi mixing chamber directly above the needle valve.

The trailers were tanks which could be cast off when their content was exhausted.

With trailers to supply oxygen and fuel, figures indicate the possibility of underwater operation without surfacing for 14,000 miles!

Very reliable automatic controls made it possible to change from normal diesel operation to Kreislauf by rotating a hand wheel through a few revolutions. During normal surface operation, exhaust gases did not enter the return line but were deflected overboard.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Engineers Seek Unformity In Nondestructive Testing

BASED ON PAPER* BY **D. M. McCutcheon** Head, Applied Physics Division
Ford Motor Co.

GLARING misapplications of nondestructive testing during the last war led to formation of a group under the SAE Iron & Steel Technical Committee. This group[1] is studying the nondestructive testing field to evolve essential technical information and to establish recommended practices where practical.

Can methods and techniques be sufficiently standardized so that recommended practices or standards of acceptance will emerge? The answer in many cases will be that it cannot be done. But something must be done to rationalize the many nondestructive tests available to industry.

Where specific recommendations, pro-

*Paper "Application of Nondestructive Testing to Automotive Parts," was presented at SAE Summer Meeting, French Lick, June 7, 1948.

[1]McCutcheon is chairman of Division XXV, Nondestructive Test Standards for Ferrous and Nonferrous Materials, of the SAE Iron & Steel Technical Committee.

Types of Nondestructive Testing

Impact production tests on crankshafts

Macrophotograph of etched cross-section of two spindles

Bend test on truck axle housing

Table 1 - Nondestructive Test Methods and Their Application

Type of Test	*Field of Application*
1. Visual Inspection	General.
2. Sound or Percussion	Usually a rough qualitative test. With electronic equipment, quantitative tests may be possible.
3. Analysis a. Spectroscopic b. Spark Identification	General. May not be a routine test. Widely used for sorting and general identification.
4. Physical a. Impact b. Pressure c. Bending d. Torsion e. Hardness f. Proof Loading g. Fatigue	General. Type of test and limits established for a specific job. Other physical tests may be included, such as sampling tests to destruction; stress analysis for engineering information.
5. Electrical a. Conductivity b. Magnetic c. Ultrasonics d. Dielectric	Fields of application expanding rapidly, limited only by the ingenuity of the test engineer.
6. Magnetic Particle	Applicable to magnetic material only.
7. Radiation a. X-Ray-Gamma Radiography b. Fluoroxcopy c. Radioactive Isotopes (Tracers) d. X-Ray Diffraction e. Radiation Detectors	Widely used on all types of materials.
8. Penetrant a. Kerosene-Chalk b. Fluorescent, Liquids and Powders c. Electrostatically-charged Powders	Finding application in production for metals and nonmetals for the detection of sharp discontinuities.
9. Statistical Quality Control	

cedures, or standards cannot be written, available technical information on a specific test should be presented. A brief, well-written presentation of uses and limitations of a test method may be just as beneficial to industry as a specific and detailed specification. Eventually it may lead to a recommended practice.

A preliminary survey of many nondestructive test instruments revealed a dearth of information. First, the technical literature and bulletins available are limited to the manufacturer of the device. Second, most experimental investigations into applications and limitations of a particular test method or device are not published. Investigations of this type usually are limited to a specific product study. Because of their limited scope, they are not considered of broad enough interest for publication.

A technical committee is the logical medium for collecting this great fund of miscellaneous technical information. A great contribution to industry should stem from the collection, analysis, and publication of technical material by the SAE Committee.

Literally, a nondestructive test is a method for determining the suitability of a part or product for the use to which it is intended, without altering in any manner those factors which affect its usefulness. A number of engineers feel this subject should include destructive tests on sample pieces, and even the entire field of statistical quality control.

Nondestructive testing applications in the automotive industry are so broad that it may be unnecessary to classify them in any way, except by type of test. Table 1 lists such classification with suggested applications.

For committee work on recommended practices, we could break down nondestructive testing into three fields which require specialized variations of the many testing methods. They are Engineering, Acceptance, and Production.

The engineering group will include test incidental to design, research, and structure or product analysis. Nondestructive tests in Engineering are believed to be sufficiently different to warrant separate treatment. Generally these tests are more critical and results are viewed and interpreted from an engineering viewpoint.

Nondestructive tests for acceptance of automotive parts are, perhaps, the most difficult to write into specifications or recommended practices. But economic value of a well-written test procedure or specification in the automotive field justifies work in this area.

A big problem to be confronted by a

CONTINUED ON PAGE 40

The KNOW-HOW of Light-Alloy Truck Parts

EXCERPTS FROM PAPER* BY
J. L. S. Snead, Jr.

Vice-President, Operations and Maintenance
Consolidated Freightways, Inc.

CUTTING truck weight with aluminum, magnesium, and high-tensile steel parts calls for design suited to these materials and brings up new suspension and braking problems.

In our experience it is unwise to use most standard iron or steel design, machining, or assembly practices with aluminum and magnesium. Long radii, sweeping curves, thick sections, avoidance of stress concentrations, shrink fits, and protection from abrasion are musts. Sharp fillets, notches, or rough handling must be avoided. Use of an insulating material between dissimilar metals to prevent electrolytic action is absolutely imperative. Bolt holes must be drilled a few thousandths undersize so that all attaching bolts are absolutely tight. Use of flat washers and lock nuts has been found to be the most satisfactory method.

Assembly of parts requiring shrink fit requires compliance with specific rules to avoid pulling the metal. Washers, wear plates, and other parts to protect the softer metals from abrasion must always be provided and properly assembled. Above all, everything touching aluminum or magnesium must be tight and must be kept tight. These things sound more difficult than they really are.

With a thorough understanding of the reasons for these rules, the precautions become routine and very few errors occur. Our maintenance men have become so accustomed to the use of light metals that we can honestly say we have very little more difficulty with them than with heavier materials.

DANGER OF THIN SECTIONS

In using high tensile steel and alloy steel castings, we have found that the most serious danger lies in a tin canning effect or flutter if the section is reduced too far. This holds true even though the section is not highly stressed. With these materials we have used many all welded structures very successfully. Many brackets, frames, cabs, and other assemblies made of the high tensile steels have been in service substantially over one million miles.

Welding is one of the most frequent causes of light material failures. It is particularly important to avoid welding heat-treated materials - whether steel or aluminum, unless it is possible to anneal, weld with the proper rod and re-heat-treat. In maintenance, this is usually impossible. Welding high tensile steel

*Paper "Design and Operating Experience with Weight-Reducing Materials," was presented at SAE National Transportation Meeting, Philadelphia, March 30, 1948.

Aluminum Parts That Cut Truck Weight

Upper Fifth Wheel

In Steel	200 lb
In Aluminum	141.5 lb
Saving	58.5 lb

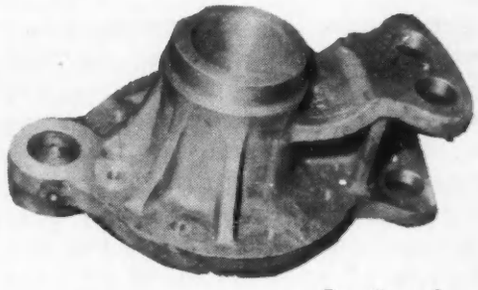
Lower Fifth Wheel

In Steel	369 lb
In Aluminum	265.8 lb
Saving	103.2 lb

Auxiliary Transmission Front Support

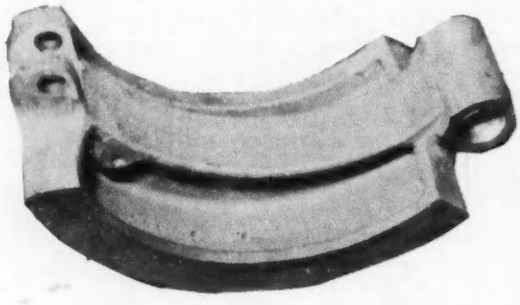
In Steel	34 lb
In Aluminum	21.8 lb
Saving	12.2 lb

Brake Spider



In Steel	43 lb
In Aluminum	20 lb
Saving	23 lb

Brake Shoe



In Steel	37 lb
In Aluminum	14.8 lb
Saving	22.2 lb

Drive Axle Housing

In Steel	240 lb
In Aluminum	171.3 lb
Saving	68.7 lb

to mild steel or welding high tensile with the wrong rod will usually result in failure at two to three hundred thousand miles.

WEIGHT REDUCTION COMPLICATIONS

Reducing tare weight always introduces new suspension and braking problems. Every time another piece is changed to reduce weight, the suspension problem is complicated by the increase in spread between sprung load empty and that fully loaded. The brake control problem is accentuated by the increased variation between axle loads - empty and loaded. Both problems are aggravated by the differences in state laws which require variations in the loading on various axles or groups of axles. This increases the spread for which it is necessary to provide adequate suspension and brakes.

We have made much progress with the suspension problem using two stage springs of chrome-vanadium on both truck drive axles and trailer rear-axle assemblies. On the trailer front axle we use a three-stage spring. At this point, maximum sprung load is twelve times sprung load when the trailer is empty. Since we must prepare for operation over long distances at high speeds with loads at any point between these two extremes, it is difficult to keep frequency and acceleration within reasonable limits.

To date, no real progress has been made in the solution of the brake control problem. We must be prepared to control truck gross loads of 42,000 lb and trailer gross loads of 45,000 lb, though the combination gross may not exceed 79,000 lb to 72,000 lb, depending on the state. At the same time, it must be possible to operate the equipment safely when empty; when the truck is loaded and the trailer empty; when the rear half of the trailer is empty but the front half loaded; or at any combination of those and other possible conditions.

Brakes of extremely high capacity are absolutely necessary to bring full loads down long hills at reasonable speeds. Most of these hills range from 10 to 55 miles in length. Grades range from 6% to one small stretch of 12%. Snow and ice are encountered on most of the passes for at least six months of the year. This problem combines with the lag in brake application and release, and the long minimum brake application to create a situation which is compensated for by the skill of experienced professional drivers. But this situation needs correcting.

WEIGHT REDUCTION PROFITABLE

On the basis of our experience we can say with assurance that the use of weight-reducing materials for a great many parts of inter-city four-wheel drive, six-wheel trucks, six-wheel full trailers, four-wheel tractors, and dual-axle semi-trailers is practical. Average net loads can be increased enough to make weight reduction profitable if space is provided for the additional load. Competent men can readily be trained to process, assemble, and maintain parts made from weight-reducing materials.

And it is not at all unreasonable to expect life in excess of one million miles without excessive maintenance from vehicles using such materials for a substantial percentage of their entire tare weight - even when operated under the most severe climatic conditions over extremely mountainous terrain on high speed, long-distance runs with gross loads varying up to the legal limits.

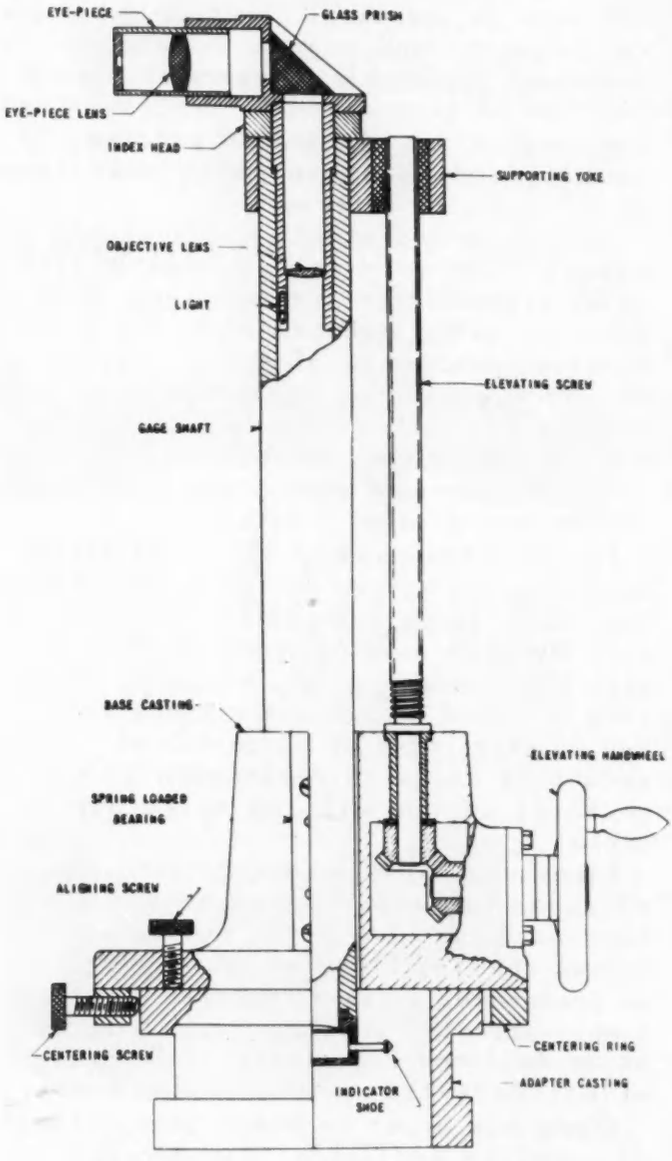
Proof of the pudding is in the eating. In 1940 we set out to design a completely-new 60-ft truck and trailer combination with the most loading space we could get, with the lightest weight we could obtain. This we hoped to achieve without exceeding an extra cost of $1 per lb of weight reduction and with reasonable life expectancy of one million miles per vehicle.

Experience with a considerable number of these vehicles, which have now run between 750,000 and 900,000 miles has proved that (with one or two exceptions): no premature failures occurred - even in highly-stressed aluminum parts - so long as we followed sound practice in design, alloy, heat-treatment, and assembly.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmenbers.)

Engine Design Tool Found In

BASED ON PAPER * BY
Melvin E. Estey
Supervisor, General Research Department
Perfect Circle Corp.



● Fig. 1 - The cylinder contour gage

A cylinder contour gage that detects abnormal contour conditions and helps find the remedy has proved useful in designing and redesigning engines.

Essentially the contour gage reveals actual cylinder shape rather than size, although it does the second job too. It determines cylinder shape by direct measurement of differences in cylinder radius throughout the cylinder length, from a fixed co-linear axis. This is the true axis of the cylinder, as near as can be determined.

The contour gage, Fig. 1, consists of a 0.0001-in. reading dial indicator on the lower end of a 2 1/2-in. diameter tubular gage shaft. The shaft is so mounted that it may be accurately centered in the cylinder, then raised, lowered or rotated to bring the indicator into position to explore any desired cylinder wall location.

A heavy base casting supports the gage shaft with three bearing shoes, one being spring-loaded to maintain constant gage shaft alignment within the base casting. The gage shaft may be rotated by capstan pins and raised or lowered by a hand wheel. Through a bevel gear, the handwheel turns a lead screw which is threaded into a collar on the upper end of the gage shaft.

The indicator is horizontally mounted on the lower end of the gage shaft. An optical system on the upper end of the hollow gage shaft provides an enlarged

*Paper "Cylinder Wear and Distortion as Measured With The Cylinder Contour Gage," was presented at SAE National Passenger Car and Production Meeting, Detroit, March 5, 1948.

Cylinder Contour Gage

view of the indicator dial. The optical system remains stationary, regardless of gage shaft rotation. The indicator is adjusted for cylinder size by proper selection of insert between the indicator and the contact point. The contact point is a 0.030-in. radius tungsten carbide button on which wear is negligible. Total indicator travel is 0.060-in.

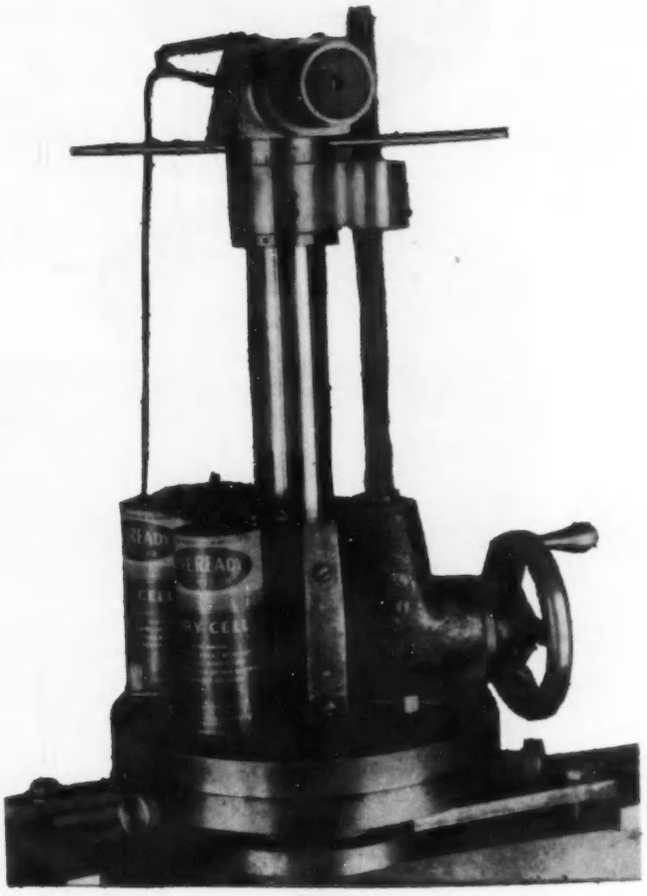
An auxiliary adapter casting, used for setting the gage up for cylinder contour investigation, is toe-clamped to the top of the engine block, in approximate alignment with the cylinder being measured. In case of aircraft type individual cylinders, the adapter casting is fastened to the flange around the lower end of the barrel. The contour gage then is positioned on top of the adapter casting, as in Fig. 2.

Centering screws pass through an annular ring on the bottom of the base casting and bear on the adapter casting sides. These screws are located at 120-deg intervals around the base and allow the entire gage assembly to be shifted laterally to center the gage shaft at the upper end of the cylinder. Equal indicator readings at the three equally-spaced locations around the cylinder assure accurate centering.

To measure cylinder contour with the cylinder head in place, a 3-in. hole is bored in the head, in line with the cylinder and the adapter casting mounted on the head. The contour gage is mounted on the adapter casting and the gage shaft inserted into the cylinder through holes in the head. Centering adjustments are made and readings taken in the normal manner.

Minimum size cylinder which can be measured is determined by gage shaft size. Limiting maximum size is the length deemed advisable to extend the indicator contact point and also ability to mount adapter casting on the cylinder. Maximum useable gage shaft length is 11 in., although this can be increased easily by using a longer shaft.

Some examples of abnormal cylinder contour together with possible methods of



● Fig. 2 - The cylinder contour gage in operating position

eliminating them follow. Models illustrating these conditions were made by plotting and amplifying cylinder radius deviations on polar coordinate charts. Cardboard discs were cut out to represent the shape at each measured level within the cylinder. The discs are stacked in relative position to give visual interpretation of cylinder shape. Radius deviation is amplified 300 times.

Case 1

This investigation was conducted on a dry sleeve type engine. It had a history indicating lack of conformability between rings and cylinder wall, resulting in high rate of oil consumption. A cylinder contour check of a new engine without the cylinder head in place, revealed that while the cylinders were fairly straight, they were somewhat triangular in shape. (See photograph "A")

At 2 1/2 in. below the cylinder top, radius difference between "points" and "sides" of triangle differed by as much as 0.006 in. "Points" of the triangle coincided in all cases with location of cylinder-head cap screw bosses, which were tied into the cylinder wall.

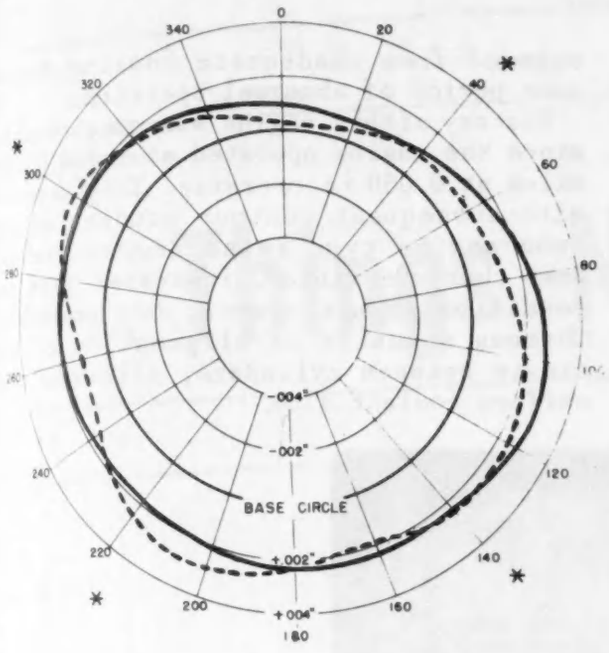
Although a triangular shape was found to exist in the new cylinder (which is not desirable), it didn't seem to be the cause of high oil consumption. Further studies were made to investigate effect of engine assembly forces.

A thin steel embossed gasket was tried to reduce or eliminate distortion. Such gasket, with the head fastened in place by cap screws, reduced maximum difference in radius to 0.0032 in. Tightening the cap screws above recommended torque, loosening them and retightening them to recommended torque failed to reduce cylinder distortion.

Next the block and head were assembled using through bolts instead of cap screws, and with this same type gasket. With torque normally applied to the cap screws, maximum radius difference was found to be 0.0014 in. See model in "B".

Apparently a combination of gasket and cap screw action in this particular engine caused the distortion. Only by correcting both can it be reduced. Since this engine doesn't readily allow use of through bolts, elimination of tie-in of cap screw bosses with cylinder wall is the most practical solution. Also overall structural stability should be increased to resist distorting forces of the present design.

Case 2



An engine block, in which a core shift had caused a 5/32-in. difference in cylinder wall thickness, was measured for cylinder contour, both with and without the cylinder head in place. The cylinders were found comparatively round and straight without the head in place.

When the cylinder head was fastened in place with normal torque, the cylinder radius on the thin wall side of the cylinder decreased a maximum of 0.0009 in. The contour chart shown was taken 1 in. from the top end of the cylinder. Solid line is contour without cylinder head; dashed one with cylinder head. Asterisks represent cap screw boss locations.

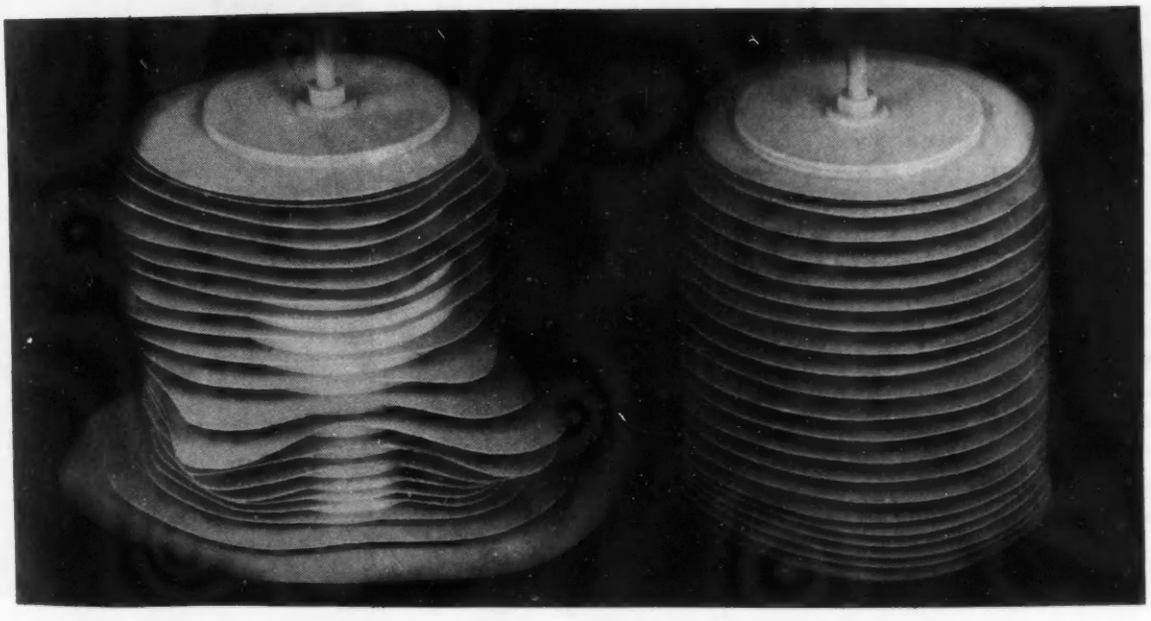
Obviously the cause of this distortion was the core shift. It decreased cylinder rigidity in the thin wall area.

Case 3

An aircraft engine manufacturer considered use of a prefinished sleeve which could be installed in the field by service personnel. Use of such sleeve would obviate need of factory finishing resleeved cylinders. A contour study was made of a cylinder sleeved in this fashion as well as of one finished in place at the factory after installation.

A 0.012-in. interference fit between sleeve and cylinder produced a serious distortion in the cylinder with the prefinished sleeve, as shown by the model. The same distortion was undoubtedly present in the other sleeve; but the final finishing process removed it.

Responsibility for distortion in this case is directly traceable to the large interference fit and use of a cylinder having a wide variety of structural characteristics. Of course the manufacturer shelved the notion of using a prefinished sleeve as a result of this contour investigation.

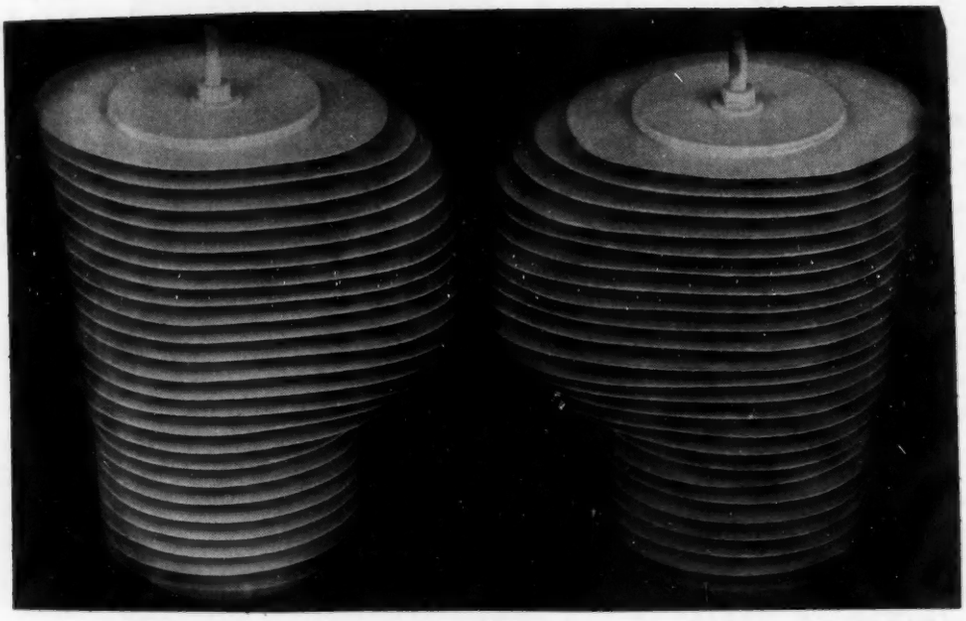


Case 4

An automotive engine with siamese cylinders was disassembled and found to be badly scuffed, particularly in areas adjacent to the common cylinder wall between two cylinders. A cylinder contour, (see photograph) revealed the cylinder radius at the siamese section to be 0.010 to 0.011 in. greater than at any other location.

Since this radius difference was all within the ring travel, it was attributed directly to accelerated wear. And wear stemmed from inadequate cooling during some period of abnormal operation.

History of this engine was questionable, since the engine operated at least 90,000 miles at 0.050 in. oversize. This together with subsequent contour studies of the same engine type revealing no similar wear characteristics, indicates that the condition is not common, but possible. Obvious solution is elimination of the tie-in between cylinders, allowing more uniform coolant flow.



Case 5

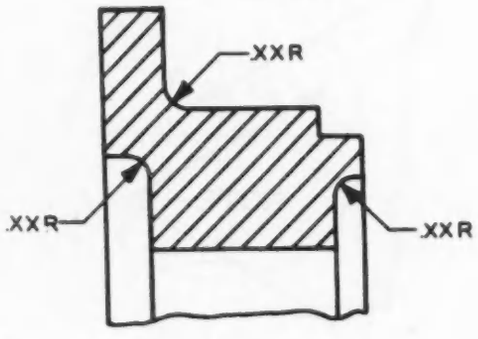
Results of measurements made on a wet sleeve removed from an engine typifies the usefulness of the contour gage.

While this sleeve was comparatively round throughout its length, the axis was found to be nonlinear. (The contour model shows this.) Maximum departure of the cylinder axis from a straight line was 0.0025 in. Improper alignment of machining equipment used in processing the sleeve probably produced this. Use of a diameter measuring gage would indicate degree of roundness, but not the nonlinear axis condition shown here.

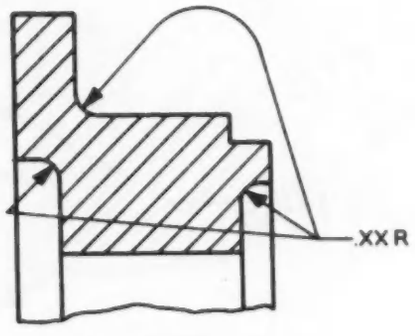
(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Things Not To Do In Drafting

These recommendations for solving common drafting problems have been prepared for inclusion in the SAE Aeronautical Drafting Manual by the Committee that authored the treatise. Useful also in mechanical drawing in other fields, these tips will help draftsmen and engineers present a clearer picture to the shop and to others who must interpret their message.

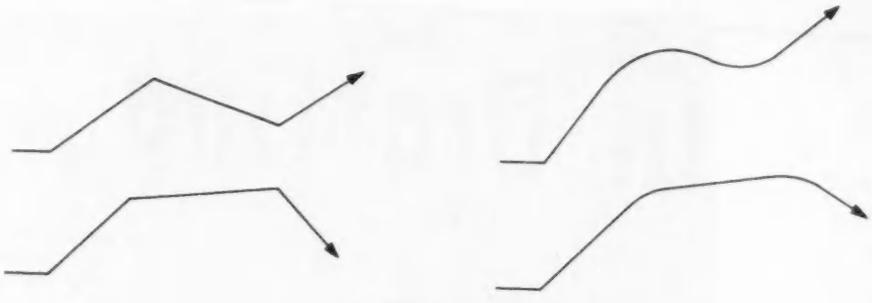


Do This

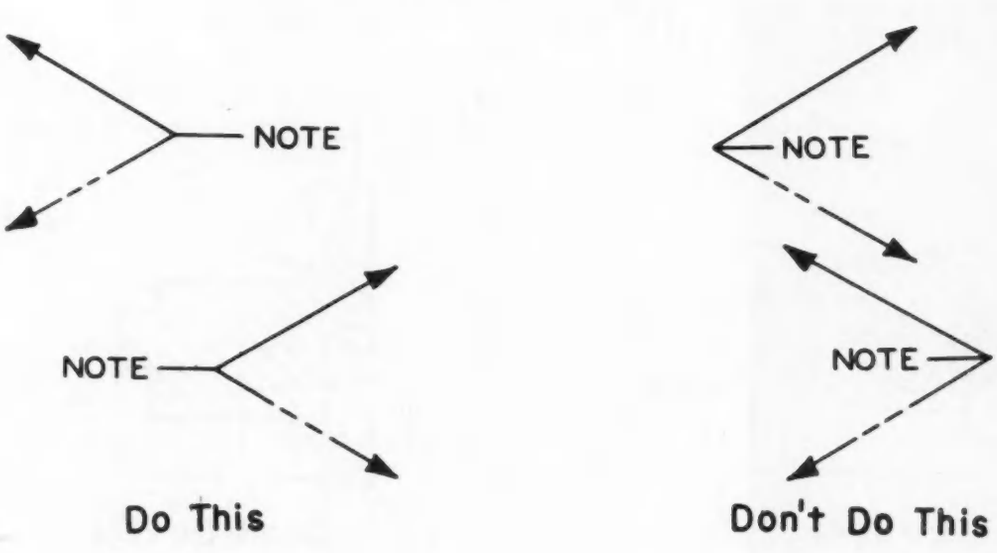


Don't Do This

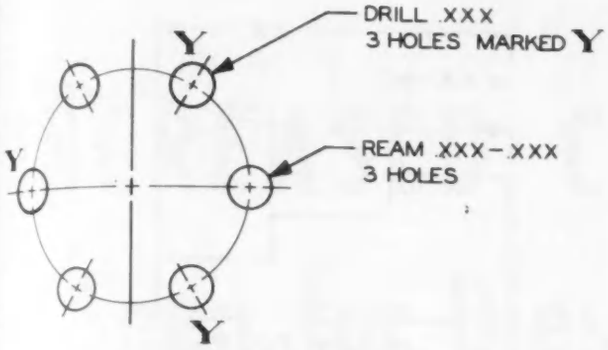
A. Notes and dimensions should be repeated - not duplicated - as often as necessary to avoid long leaders or line crossing.



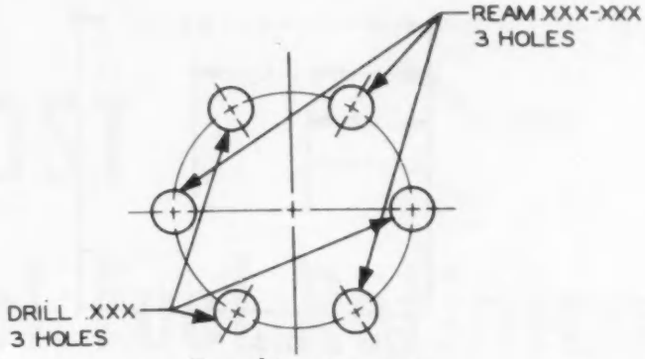
B. Leaders should be straight lines. They are bent or curved only when necessary. A radius or angle is used when a leader must be curved or bent. It is recommended that: (1) only one curve or one bend should be made in a leader; (2) the radius should be used to curve a leader when it is long or in a group of leaders; (3) the angle should be used to change the path of a short leader.



C. It is recommended that leaders do not result in an acute angle. Obtuse angles are preferred.

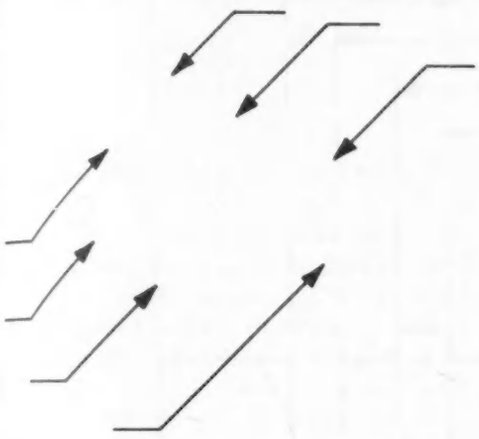


Do This

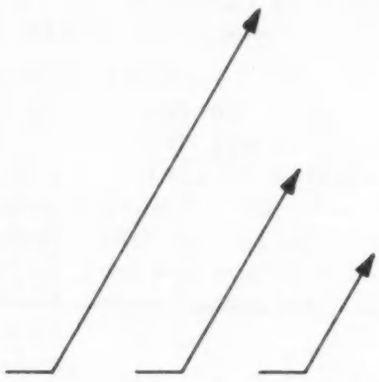


Don't Do This

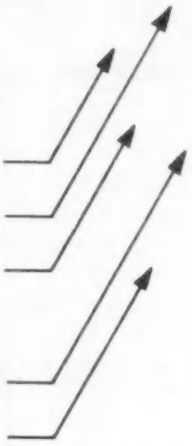
D. Letter symbols instead of leaders should be used if the use of leaders would impair the legibility or appearance of the drawing.



SAME ANGLE
THROUGHOUT THE DRAWING

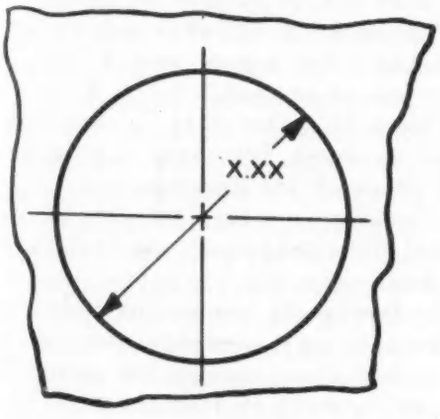


ITEMS PLACED
SIDE BY SIDE

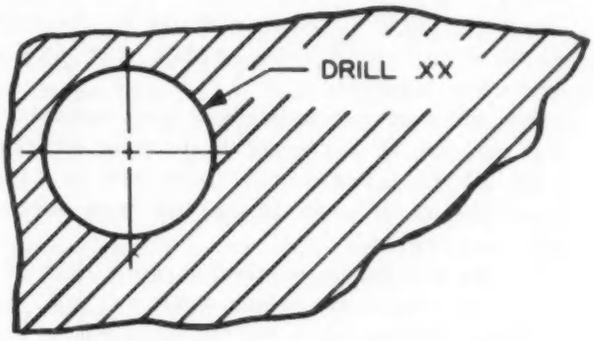


ITEMS PLACED ONE
ABOVE THE OTHER

E. When practical, all leaders should be at the same angle and all groups of related or unrelated items should be aligned horizontally or vertically. Avoid the use of long leaders. Leaders should not be drawn free hand.

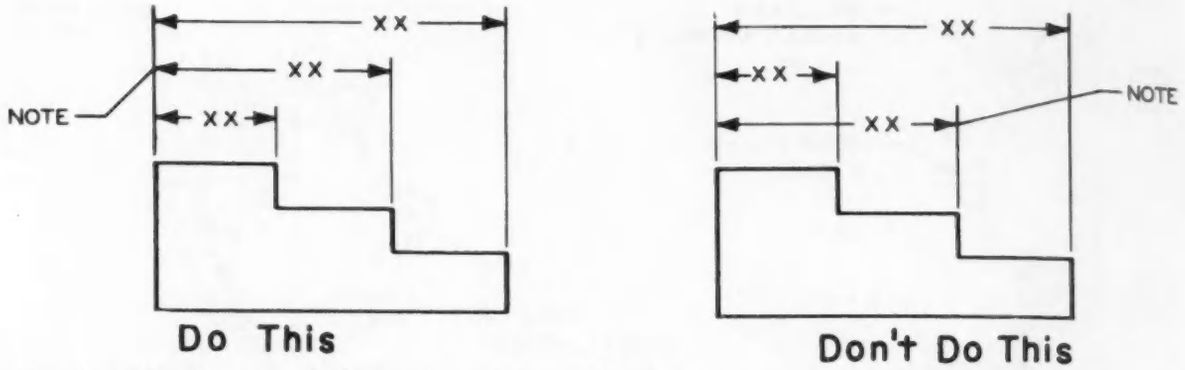


SPACE EXISTING

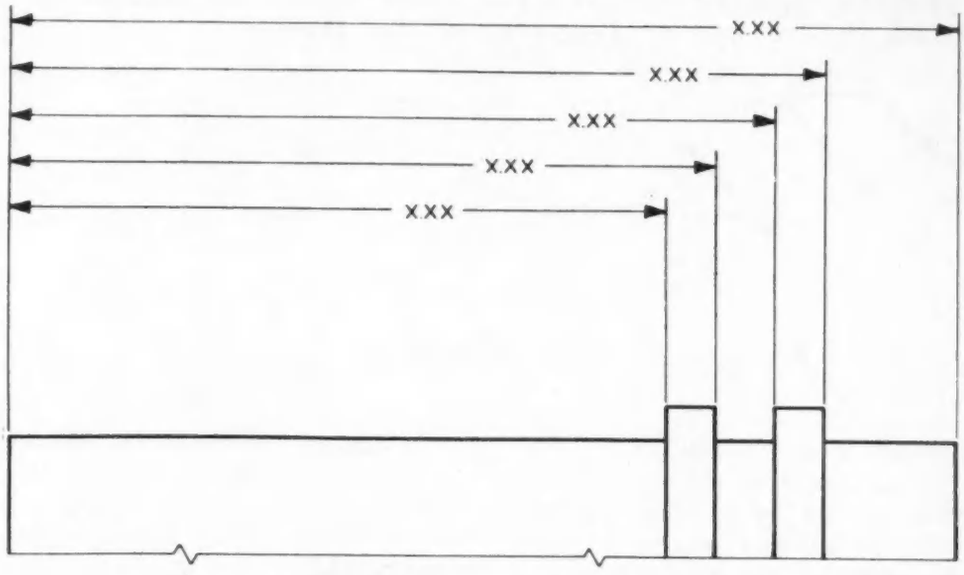


SPACE PROVIDED

F. Dimensions and notes should be placed outside a view whenever practical. A dimension or note placed inside a view should be located in an open space existing in the view or in one provided by deleting part of the view.



G. Extension, leader, and dimension lines should not cross each other unnecessarily.



H. When there are several parallel dimension lines from a base line, the dimensions should be located adjacent to the terminal ends of the dimension lines.

11 WAYS TO BETTER DRAWINGS

1. Drawing equipment - such as scales, straight edges, triangles - having flat surfaces should be kept clean.
2. The portion of a drawing which is not being worked on should be kept clean and if necessary covered.
3. After work on a drawing has been completed, the back of it may require cleaning, especially after a drawing is changed or after work on the drawing is traced from another pencil drawing.
4. Don't fold drawing originals. Only roll size drawing originals should be rolled. The inside diameter of a rolled original should not be less than 1 inch.
5. A good grade of drafting tape has a special adhesive which will not damage or discolor the surface of the drawing.
6. The correct erasing medium to use should be determined before an erasure is made. Don't use a knife, the edge of a ruling pen blade, or a glass or sand eraser to make erasures. Take care not to roughen or remove the surface of an original when making erasures. Don't use a dry eraser when a special eradicator should be used.
7. The blades of an ink drawing instrument shall not be so sharp that they will cut through the surface of the drawing.
8. When a change is made, lettering to use shall conform with that (slant, vertical) previously used on the drawing.
9. Don't voluntarily change the lettering size or style established for general drawing use. Avoid overlapping the characters or crowding information into too small a space.
10. Don't extend center or extension lines from one view to another except when it is required for clarity.
11. Use the proper hardness of pencil to suit drawing medium, in order to obtain legible reproductions without engraving.

INCREASED COST Seen for Diesel Fuel Refining

EXCERPTS FROM PAPER* BY J. R. MacGregor, G. R. MacPherson, & P. L. Pinotti California Research Corp.

COMPETITION for petroleum distillates boiling in the range of 350-750F is tremendous. In 1947 consumption of these fractions as diesel fuels and heating oils was more than 150% of 1941 consumption. Additional domestic and industrial heating facilities brought much of this market growth, but diesel fuel consumption increased a higher percentage than did the heating oils. These factors, coupled with the increasing use of virgin gas oil of diesel fuel boiling range as charging stock to catalytic crackers, have so intensified competition for this stock that to meet the demands much cracked oil is, and more soon will be, marketed in furnace oils and diesel fuels. Increased use of cracked stocks as well as less desirable virgin gas oils in diesel fuels introduces additional refining steps that increase the cost of manufacture, especially if diesel fuel quality is to be maintained or improved.

Diesel-engine manufacturers frequently specify in detail the quality of fuel to be burned in their engines. In the past some of these specifications have been so restrictive that petroleum refiners have found it necessary to produce special grades, such as automotive and locomotive diesel fuels, in addition to their regular grade. Some refiners also produce a bunker grade, which may be either a distillate or a residual fuel. The latter is used in many large, low-speed diesel engines. Since only a small proportion of diesel engines burn residual fuel, only distillate fuels will be discussed here.

SOURCES

As long as a substantial amount of crude petroleum is produced, there will be distillates suitable for the production of high-quality diesel fuels. In almost all regions where it is produced, the majority of newly discovered fields produce oil from the deeper zones. Usually the deeper the zone the older it is in geological age; and, generally, the older the zone the more paraffinic the crude oil. Gas oils from paraffinic crudes are of high ignition quality and usually of low sulfur content. Exceptions to the latter are gas oils from Middle Eastern crudes, which have 1-2% sulfur by weight.

In the event of a petroleum shortage, high-quality diesel fuels can be obtained from synthetic oils, such as those produced by the Fischer-Tropsch process. Shale oil is less suitable as a source of diesel fuel, but it is believed that if it would become necessary to produce large volumes of high-quality diesel fuel from shale oil, techniques could be developed that would be commercially fea-

*Paper, "Production and Performance of Diesel Fuels," was presented at the SAE Summer Meeting, French Lick, Ind., June 10, 1948.

sible. They would, however, be more expensive than those used for the production of diesel fuels from petroleum. For this and other reasons it will probably be many years before a substantial amount of diesel fuel is produced from shale oil.

Vegetable oils have been reported to be suitable substitutes for petroleum diesel fuels, but considerable development work would be required before facilities for large-scale production of such fuels could be designed and constructed. It is probable that extensive development work on diesel engines would also be required.

In 1941 about 75,000 bbl of distillate was used daily as diesel fuel, whereas in 1947 this had increased to more than 190,000 bbl. The 1947 demand for diesel fuels was thus more than 250% of the volume consumed in 1941, and the forecasted demand for 1948 is nearly 300%. It might be observed that the advent of compounded diesel-engine lubricating oil in the 1930's broadened the field of utilization of high-speed diesel engines and thereby increased their popularity.

With the modernization of refining facilities, more and more catalytic cracking capacity is being installed. These plants are more costly than thermal cracking units; consequently, it is economically desirable to obtain the maximum production of gasoline from them. To do this, straight-run gas oil fractions in the diesel fuel boiling range must be used as charge stock. The next best feed is heavier straight-run gas oil, and the least desirable is the partly cracked gas oil from the catalytic cracker. The trend is, therefore, toward diverting saleable straight-run gas oils to catalytic cracking. To replace this loss and to provide sufficient stocks for the increasing market demand, much catalytically and thermally cracked gas oil is finding its way into gas oil sales and large volumes are being burned as diesel fuels.

The ignition quality of a cracked gas oil is not as high as the corresponding straight-run gas oil from the same crude; hence, if diesel fuel quality is to be maintained, the catalytic and thermal gas oils used in diesel fuels will both require extensive refining. Although refining processes for these stocks are known, some difficulties may be encountered in their commercial application. The price of high-quality diesel fuel in some areas is nearly up to that of gasoline, and as further refining of diesel fuels becomes necessary this price differential may be further reduced.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Nondestructive Testing

CONTINUED FROM PAGE 26

committee considering this subject is jurisdiction. There are many technical groups handling material and product specifications who have incorporated well-established test procedures in their general specifications. At present there is no intention to disturb this procedure. Nondestructive tests pertinent to a particular material or product should remain under jurisdiction of these product committees.

Production nondestructive tests are of the "go-or-no-go" variety. But there are many exceptions to this simple classification. Yet many production tests are so simple that no special comments need be made, such as blueprint specifications on Brinell hardness limits.

Introduction of more complex production testing methods points to a need for careful technical appraisal of them if these tests are to do good. For example, many engineers believe that many useable castings were scrapped by misapplication of X-ray and magnetic particle inspection during World War II.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

ECONOMICS through STANDARDIZATION

EXCERPTS FROM PAPER* BY **William Littlewood**
Vice-President of Engineering, American Airlines, Inc.

STANDARDIZATION is a tool through which simplification can be made to pay dividends in economy, efficiency, convenience, comfort, dependability and safety, without sacrificing performance or engineering excellence.

Needs and rewards for cargo handling simplification and efficiency are obvious.

We must look to:

- Mechanics, their supervisors, and airline engineers, and ask what is the simplest, uniform manner in which they can be aided to analyze and correct troubles, and care for the complex equipment;
- Airline management and inquire by what reasonable standardization and simplification can the procurement of aircraft be made more economical, and the operating units obtained be more uniformly satisfactory, and the operating problems simplified;
- Aircraft and equipment manufacturers and, with them, recognize possibilities of economies and quality control inherent in reasonable standardization;
- Designers and encourage adherence to simplification and reasonable standards.

During the early Twenties de-emphasis on aviation relegated the industry to barns and sheds and World War I lessons in the need of standardization were forgotten. Even military aviation could struggle only feebly to maintain a semblance of an arm of the services.

Advances of commercial aviation during the late Twenties and Thirties were paralleled by military aviation progress with its revolutionary developments in performance, capacities, ranges, materials and methods of construction, application of new aerodynamic knowledge, and rapidly developing techniques of manufacture and operation.

The early Forties saw greatly improved airplanes; advancement in materials, structures, and performance; improved manufacturing tooling and techniques; a startling diversity of airplane models with uncontrolled dissimilarity of detail.

National security demanded elimination of all non-essential equipment differences between the aviation arms of the military services, and reduction of extreme and unneccessary diversification of materials, accessories and equipment, engine and propeller components affecting production, and produced a semblance of order in installation and interchangeability, airplane installation elements, and aircraft details and arrangements.

The Society of Automotive Engineers was selected to perform these services and to sponsor and coordinate the industrial standardization activities in the aircraft engine, propeller, materials and processes, and accessories and equipment fields.

Benefits of these activities were, of course, indirectly reaped by commercial air transportation although the urgent

*Paper "Standardization and Simplification for the Air Transport Industry" presented Dec. 2, 1947, at the SAE National Air Transport Engineering Meeting, Kansas City.

necessity was then strictly military and decisions were greatly influenced by the stringent shortages and requirements of the times. These decisions obviously require peacetime review, and it is plain that the full light of standardization and its benefits has not been brought to bear on the broad scope of postwar commercial aviation.

The role standardization must play in the postwar era is similar to that of wartime except what was previously accomplished by the armed forces and industry under stringent necessity must now be accomplished by the voluntary actions of all members of the business. Toward this end, the Services, the Air Transport Association of America, the National Aircraft Standards Committee, the International Air Transport Association, the Society of Automotive Engineers, and other prime Government and industry agencies have continued in their firm support of standardization.

Standardization need neither throttle nor restrict engineering development or progress.

Standards are not compulsory - but if good and readily available, are a real help and convenience in development and design, and are of incalculable value in production and use. The benefits of general, non-restrictive standards available early in the history of a new development can guide future products and assure reasonable interchangeability.

Standardization is useful only if it increases the safety or economy of an operation. Safety cannot be jeopardized for the sake of individuality, although economy can easily be slighted in the name of expediency or distinctiveness. Expedience is often the consequence of poor planning. Distinctiveness, if carried beyond economic justification, is a reflection on business judgment.

This industry today can charge very few costs to competitive features requiring physical differentiation, although there are many competitive assets such as routes and cities served, appearance features, excellence and dependability of service, company morale, and customer-employee relationships. Here standardization would create no benefits.

Justifiably competitive cost items as advertising, publicity, and personal passenger services come to about 4% of total current expenses. It is the remaining 96% of current expenses that is the target for economical savings, many of which can be realized by simplification and reasonable standardization.

Standardization loses its value when the standard is so finely drawn or so arbitrarily adhered to as to stifle betterments in design or procedure.

Detail standards specifying sizes of all accessory unit parts would be restrictive, but envelope requirements stipulating only the maximum space volume permissible and possibly interchangeable mounting and connection arrangements, would not be. If the industry agreed on one powerplant, the value of standardization would undoubtedly be breached, because manufacture by a single concern would dampen the reasonable incentive for development.

Safety must always have the most serious consideration. In the past 10 years instruments and controls in the cockpit of an average air transport aircraft has more than doubled because of the increase in number of engines and related components, additional accessory and equipment features, pressurized and high speed flight conditions, and need for more precise navigation under limited visibility conditions.

Resultant differences between cockpit layouts in airplanes of different design and manufacture, all intended to perform about the same tasks and be operated and controlled by similar procedures and techniques, are unjustifiably numerous.

Helpful and excellent ideas have come from the military service, manufacturers, pilots as individual and groups, and airline engineers and operators. But there has been no coordinating agency to effect the standardization necessary to achieve the needed uniformity and simplification. The resultant penalties in manufacturer's design and production headaches, operating training requirements, maintenance problems and unnecessary complications are apparent. Surely there is need for simplification and standardization in the cockpits of our transport aircraft.

A cursory inspection of interchangeability lists reveals 27 different types or models of altimeters, 24 clocks, 8 auto-pilot oil pressure gauges, 8 de-icer pressure gauges, 11 vacuum gauges, 11 directional gyros, 16 artificial hori-

zons, 20 airspeed indicators, 26 turn & bank indicators, 11 tachometer generators, and 18 fuel tank quantity units.

Excuses are not plausible when we reckon the enormous savings in inventories, records and stocking facilities which would result from a reasonable standardization in this field.

The war partially forced on aviation the mass production benefits common to many other industries. We must not take esoteric pride in tailor-made products because high quality is achieved at low cost. With slight changes items used in other industries are available at half the cost.

Duplicated facilities and personnel in terminal operation must be eliminated. Some progress has been made but the field has only been scratched. Costly items such as fueling units, air conditioners and power units need standardization.

If we cannot standardize on three or four rugged, adjustable, utilitarian ladder designs, the touch of Midas will never strike us. It has been estimated that the scheduled airlines have at least $20,000,000 worth of ground equipment, a substantial percentage of which might have been saved by simplified, uniform designs and consolidated volume orders. Again we take a financial licking on multiple engineering costs, which are reflected in the high price of the many type units.

Standardization can be very important in large airline construction programs such as building 20 or more hangars as may well be required at Idlewild Airport. If the airlines can agree on a reasonably standard hangar and its elements, it is possible that many hundreds of thousands of dollars of engineering time and construction costs can be saved.

We can make money by attracting more customers through an improved standard of passenger comfort and service. Little things make friends and influence people - particularly the considerable army of marginal customers. A passenger does not normally look for an ash tray until a few seconds before he has to use it. Then he must find it and with one hand must twist, push, pull, or slide the mechanism, as the case may be.

The next search may be finding how to recline the seat which is accomplished in a number of unexpected ways. There may also come a time during the flight when it is necessary to locate the lavatory. The passenger will rise, go forward or aft - often he cannot be sure which way - and then after some confusion may test his ingenuity on any of several types of doors and latches. These are typical of details which are a constant source of annoyance if they may not be instinctively found and operated. Standardization of such features does not steal from the true opportunities and needs for individual design and ingenuity.

We have reached a degree of uniformity in radio equipment but the variation of types of fasteners and fittings is extensive on the same and different model airplanes. The number of units adds up to an appreciable cost by frequency of maintenance and repair. Hidden costs of stocking, handling and special tools required are also accentuated by multiple dissimilar components, even though the units are small and of apparent minor importance.

Our traffic and flight groups have established procedure standards which have simplified air travel tremendously, but we engineers have not even agreed on standard size servicing fittings, wheel chocks, power requirements of motor generators, locations and designs for doors and exits, and cockpit arrangement and instrumentation. I do not suggest any new or novel solution of our problem.

Let us make full use of established aviation standardization agencies, notably the NASC and the SAE, to pursue the reasonable application of simplification and standardization to all our air transport engineering thinking with the same zeal that we did under the drive of war. Sir William P. Hildred, Director General of the IATA, epitomized my plea for standardization by saying:

"Air transport is the only thing that man has invented lately that will make this a better world. Uniformity is the only way to lift it from its present trifling status to the inconceivably great thing it can become during the next decade."

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

(This paper will be published in full in SAE Quarterly Transactions.)

Instrument MISINTERPRETATION -

ALTHOUGH psychological research on the reading of aircraft and other instruments is still in its infancy - so that the basic principles of feeding information to a human being via an instrument dial have not yet been absolutely established - certain tentative conclusions can be laid down as the result of research work done to date:

1. Most errors are due to faulty *interpretation* of the information presented rather than to difficulties in legibility or acuity. Thus, it is clear that mere increases in size and amount of illumination are not enough. Rather, it is necessary to find methods of indication that simplify the interpretational processes interposed between the seeing of the instrument reading and the making of the appropriate control action.

2. A large number of instruments can be checked most rapidly and accurately when they are designed so that all pointers head in the same direction for the normal reading. This arrangement is of particular importance in the case of engine instruments, many of which are of concern only when their readings fall outside the normal operating range. Uniform pointer alignment thus allows the pilot to detect quickly any indications of malfunctioning.

3. The 9 o'clock position appears to be better than either the 3 o'clock or the 12 o'clock position for the uniform alignment of pointers on a large group of instruments.

4. Direction of movement is an important variable affecting the speed and accuracy of qualitative instrument reading.

A. For instruments whose readings increase or decrease with little or no direct relation to a control motion (such as outside air temperature thermometers and oil pressure gages), the conventional way is to have the scale increase in the clockwise direction on circular dials, and upward or to the right on linear dials.

B. Where knobs, cranks, levers, or switches control instrument readings, the knobs and the indicators that they control should move in the same plane of space and should follow the convention of using clockwise, forward, or upward motion of the control for increase, if possible.

If a rotary control knob moves in the same plane as a linear indicator, it appears to be best to have the indicator move in the same direction as the edge of the knob nearest the indicator.

When the indicator moves in an arc and the same plane as the knob, best results are obtained if the indicator rotates in the same angular direction (clockwise or counterclockwise) as the knob.

If the knob and indicator movements are in different planes, there appear to be no consistent operator preferences.

C. Instrument indicators that are related to attitude, heading, and position of the aircraft, as well as to the movements of the flight controls, appear to be read most quickly and accurately when the instrument motion corresponds to the motion of the airplane with respect to the earth, rather than for the instrument motion to correspond to the motion of the earth with respect to the airplane.

For example, the rate-of-turn needle is deviated in the direction in which the aircraft is turning, that is, right or left. On the remote-indicating compass the pointer rotates in the direction in which the aircraft is turning, that is, counterclockwise or clockwise. In the same manner, the pointer of the rate-of-climb indicator moves up for ascent and down for descent. These three would,

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*Paper, "Design of Instrument Dials for Ease of Reading," was presented at the SAE National Aeronautic a d Air Transport Meeting, New York, April 14, 1948.

MISREADING Seen Due to Not Poor Seeing

BASED ON PAPER* BY **Walter F. Grether**
Aero Medical Laboratory, Wright Field

therefore, be considered as airplane-reference instruments. In pilots' lingo, they give a "fly from" indication. Several other instruments follow the earth-reference principle, giving what pilots call a "fly to" indication.

5. Studies of quantitative readings of multiple-pointer instruments indicate:

A. Combining readings from two or more pointers into a single, quantative reading is difficult and causes errors.

B. A common error is reading too high by one revolution of the sensitive pointer. This is a particularly hazardous type of error when reading the altitude of an aircraft.

C. In the combining of numbers from different pointers, numerous errors result from digits being displaced or interchanged in the number series.

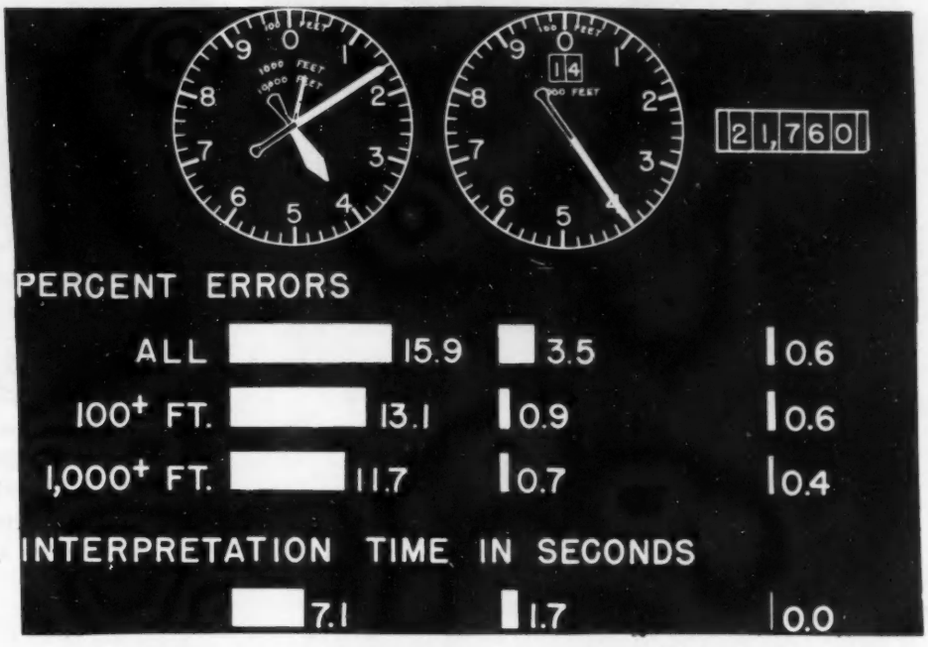
D. Misreading of the dial scale causes a high proportion of errors. In the case of the altimeter, most of these errors consisted of misreading the 20-ft graduation intervals as 10 ft. (This is the only type of error that was not directly related to the use of two or more pointers.)

E. Other types of error, which occur less frequently, may be described as omission of one pointer, interchange of two pointers, repetition of reading on one pointer, and reading to lower adjacent instead of to nearest numeral.

F. Most of these types of errors are probably unavoidable in instruments that require the combining of readings from two or more pointers.

G. All errors, except misreading of the scale, can be virtually eliminated by the use of a single-pointer instrument with a counter to indicate the number of revolutions of the pointer (as shown on the middle dial in Fig. 1).

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)



●Fig. 1 - Speed and accuracy of reading altitude from three types of indicator compared (97 Air Force pilots made 12 readings on each instrument)

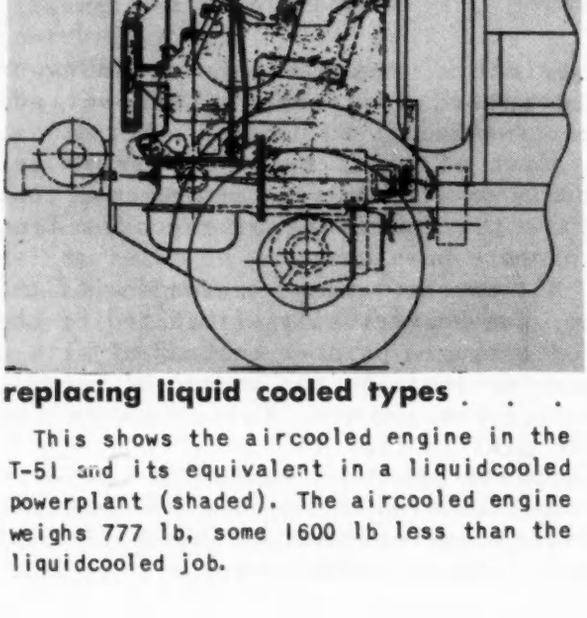
POSTWAR MILITARY V

(*Paper "Revolutionary Developments in Wheeled Military Vehicles," was presented at SAE Summer Meeting, French Lick, June 8, 1948. This paper will be printed in full in SAE Quarterly Transactions.)

New military vehicles, ... now being developed, ...

This 5-ton cargo carrier is the kind of vehicle which Ordnance feels will do a better job than its World War II predecessors. Its weight-saving design and materials are important advantages.

Another recent wheeled cargo carrier is the T-53 4x4, 3/4-ton vehicle. This design also incorporates advances such as the aircooled engine and aluminum structural components, found in the T-51.



replacing liquid cooled types . . . . . — now being standardized, . .

This shows the aircooled engine in the T-51 and its equivalent in a liquidcooled powerplant (shaded). The aircooled engine weighs 777 lb, some 1600 lb less than the liquidcooled job.

ENGINES								POWER TRAINS	
GROSS H.P.	MODEL	BMEP	FUEL OCTANE	CYLINDERS NO.	CYLINDERS TYPE	CYLINDERS SIZE	GOV'D SPEED	TRACK VEH. CROSS-DRIVE	WHEELED VEH. PLANETARY CYL.
1400	AVS-1790-5	220	100	12	V	5¼×5¼	2800	MOD. CD-1400	
1040	AVS-1790-4	160	80						
810	AV-1790-3	128	80						
685	AVS-1195-2	160		8	V			MOD. CD-850	MOD. TT-850
530	AV-1195-1	128							
500	AOS-895-1	160	80	6	OPPOSED	4½×4	3000	MOD. CD-500	MOD. TT-500
375	AO-895-2	128							
250	AO-536-1	125		8	OPPOSED			MOD. CD-270	MOD. TT-270
200	AO-536-2	100							
187	AO-402-2	125							
150	AO-402-1	100	80	6	OPPOSED	4½×4	3000		
125	AO-268-2	125		4	OPPOSED			MOD. CD-150	MOD. TT-150
100	AO-268-1	100							
100				6 or 8	V		3800		MOD. TT-90
80				6			3800		
50			80	4				ADAPTABLE FOR USE WITH ORDNANCE AUXILIARY GENERATOR EQUIPMENT	
25				2					
10				1					

Combat maintenance and supply will be simplified through a standardization program. Engine from 125 to 1040 hp will use only two basic cylinders, with high mortality parts interchangeable.

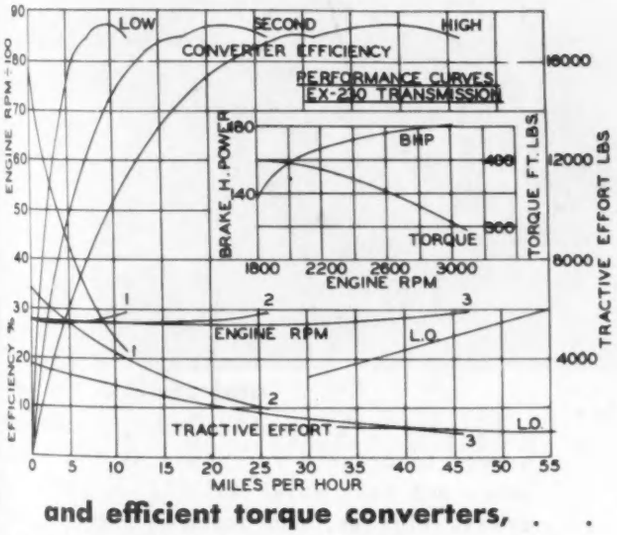
VEHICLES

BASED ON PAPER* BY
Col. Joseph M. Colby
Ordnance Department
Detroit Arsenal

Characteristics	Carrier, Cross Country T-51	Tractor, Cargo M-8
Weight empty, fully-equipped less crew	15,850 lb	35,500 lb
Payload	5 tons	5 tons
Ratio of cargo weight to vehicle weight	63%	28%
Width, overall	96 in.	117 in.
Length, overall	254 in.	258 1/2 in.
Type engine	8-cyl opposed, aircooled	9-cyl radial aircooled
Brake Horsepower	250 @ 3000 rpm	475 @ 2400 rpm
Maximum speed	55 mph	35 mph
Grade-speed ability	4.5% @ 25 mph	3% @ 18 mph
Cruising range (approximate)	300 miles	200 miles
Fording depth, max.	72 in.	40 in.

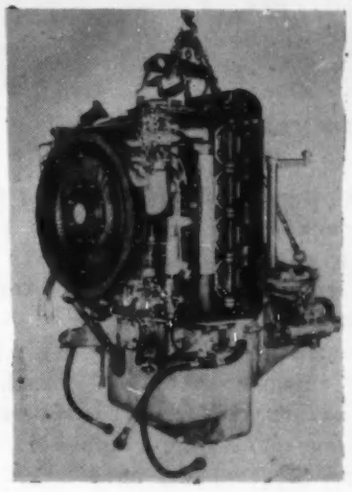
are more efficient machines. . . . . . .

This comparison shows that the T-51 can handle 2000 lb more cargo with 2200 lb less curb weight than its wartime counterpart, the M-8. This a distinct advantage for tactical planning.



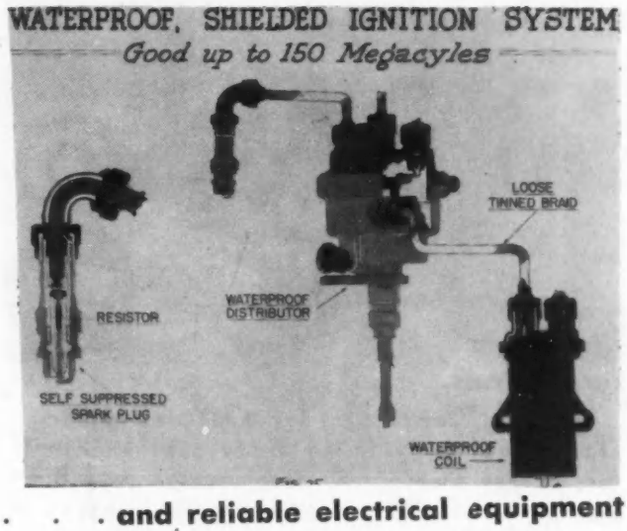
and efficient torque converters, ...

Good performance of the T-51 is due largely to its torque converter. Among the converter's tactical advantages are full exploitation of available horsepower, less need for driver judgment.



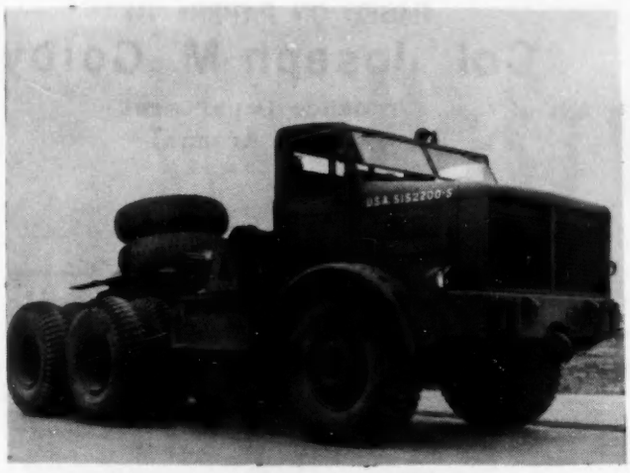
Features like aircooled engines —

Powering the T-51 is this 8-cyl aircooled engine. It has a 4 5/8-in. bore and 4-in. stroke and delivers 250 hp. Hard-to-get water and ethylene glycol in frigid zones build a case for air cooling.



. . . . . and reliable electrical equipment

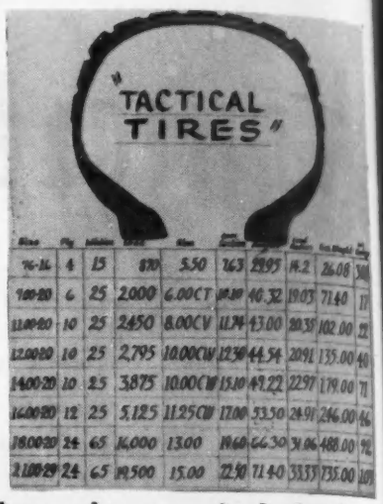
Electrical systems must be water-proof, corrosion-proof, fungi-proof, and radio-interference-proof. A 24-v system has been selected for all Army tactical vehicles to reduce component weight and bulk.



make these vehicles possible.

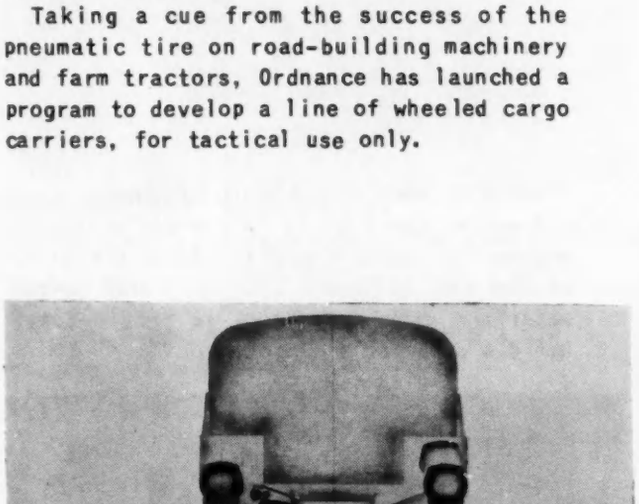
Because of these and the following developments, tracklaying vehicles are giving way to wheeled types such as this one. Tracklaying equipment is expensive to make, costly to operate.

Taking a cue from the success of the pneumatic tire on road-building machinery and farm tractors, Ordnance has launched a program to develop a line of wheeled cargo carriers, for tactical use only.



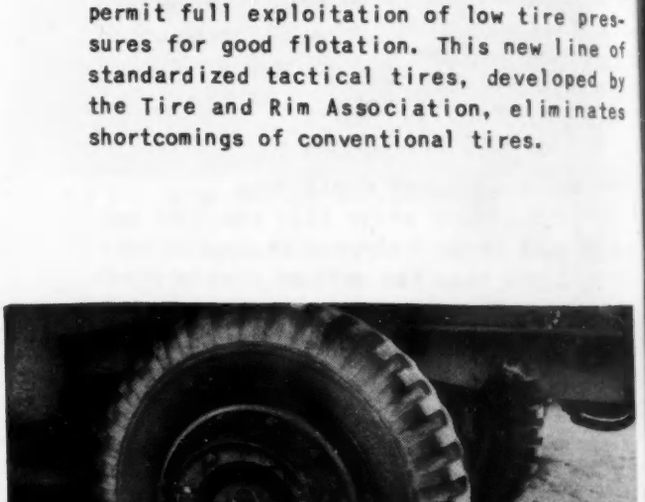
Other advances include tires,

Conventional tires weighed too much, had too great a load capacity, and too short a high-speed life. These stiff carcasses failed because they couldn't conform to irregular-shaped obstacles. They didn't permit full exploitation of low tire pressures for good flotation. This new line of standardized tactical tires, developed by the Tire and Rim Association, eliminates shortcomings of conventional tires.



suspensions,

The T-51 cargo carrier achieves good riding quality with an individual wheel torsion-bar suspension. Deep wheel movement against torsion-bar springs provides ample area beneath the spring curve to absorb shocks. Double-acting shock absorbers add to this area and dampen rebound. A second set of torsion bars provide secondary springing. Unsprung weight is greatly reduced.



and sealed brakes.

Conventional wheeled vehicle brakes proved inadequate for tactical use - mud, sand, and salt water quickly ruined brake drums, linings, and operating mechanisms. Sealed brakes overcome corrosion and erosion, make for much simpler inspection and maintenance. These brakes permit examination, adjustment, or disassembly without removing the wheel; they also exclude destructive elements.

New V.I. Improvers Minimize Lube Oil Viscosity Change

EXCERPTS FROM PAPER* BY

William L. Van Horne
Research Chemist
Rohm and Haas Co.

POLYMETHACRYLATES combine in one motor oil the viscosity properties of two or three grades. Storage and maintenance simplification as well as properties such as low pour point are available with these viscosity index improvers.

Plotting the viscosity at 210F versus the viscosity index, shows the combinations of viscosity and viscosity index which produce double-branded and, in some cases, triple-branded oils. This is shown in Fig. 1 for motor oils and in Fig. 2 for gear oils. These charts were obtained simply by plotting the various SAE Specification viscosity limits on ASTM viscosity-temperature chart D341-41 and calculating the viscosity index values for blends having the limiting viscosities.

Some overlapping occurs because of peculiarities of the SAE grading system, particularly regarding the SAE-40 grade which has a minimum viscosity specified at 130F and a maximum at 210F.

Most useful are those oils having sufficiently high viscosity indices to meet the requirements of a winter oil as well as of a heavier oil such as the combination of SAE 10W-10, 10W-20, 20W-30, or 10W-30. Comparison of the viscosities of present day motor oils shows that only two double-branded oils - SAE 10W-20 and SAE 20W-30 - would fulfill the requirements of the major portion of automotive engine oils. Similarly, gear oils which fulfill the requirements for SAE 90-140 and SAE 80-90-140 grades can be prepared using polymethacrylate viscosity index improvers.

For example, at high temperatures the viscosities of these double-branded oils are higher than for the usual oils of the same viscosity at 210F. As a matter of fact, if the double-branded oils are adjusted to have viscosity and viscosity index values in the upper part of the region for double-branding, then they are equivalent in viscosity at high temperatures to the usual oils in the next higher SAE viscosity range.

The SAE 10W-30 range is particularly interesting because such an oil can serve as an all-season motor oil and only this one grade would serve the needs of most motor car service. A synthetic motor oil has already been placed on the market which, because of its high viscosity index and low pour point, is suitable for year-round lubrication. Oil soluble polymethacrylates in petroleum base stocks

*Paper "Preparation and Properties of High Viscosity Index Motor Oils," was presented at SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 7, 1948.

offer a very flexible means of obtaining almost any viscosity together with the very high viscosity index.

Generally the cost of such blends, particularly those having properties sufficiently improved to be of the greatest practical interest, can be obtained more economically by addition of small amounts of polymer. These petroleum base-polymer blends have the advantage of possessing low-temperature viscosities, nearly the same as predicted by straight-line extrapolation on ASTM viscosity-temperature charts, while some synthetic oils show a pronounced thickening at low temperatures.

OTHER MERITS

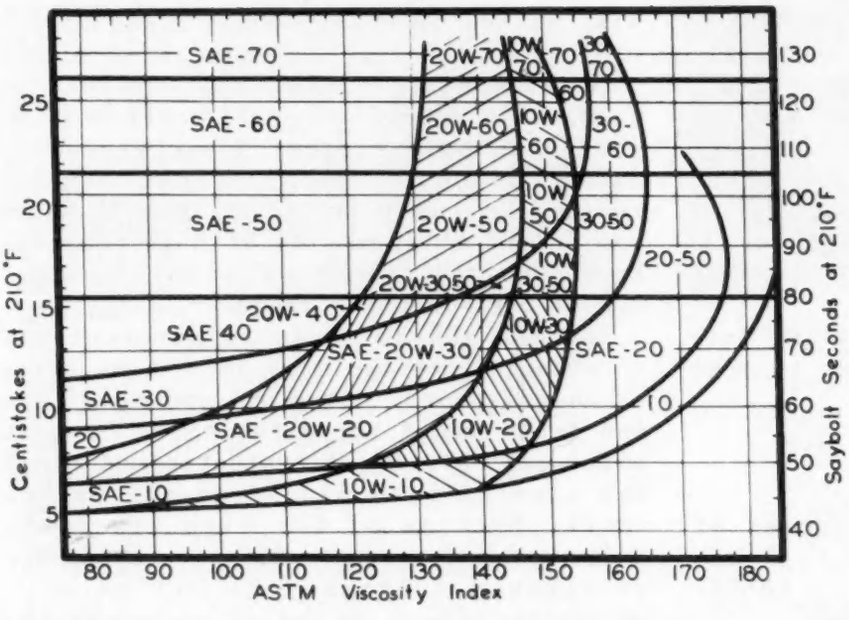
Since these double-branded oils combine the properties of a winter grade as well as a heavier oil, it is necessary that the pour point of the oils be low, and that the polymer remains completely soluble under all conditions. Usually a pour depressant is used to obtain the low pour point. Fortunately, for the purpose of preparing high viscosity index motor oils, certain polymethacrylates have been found to be powerful pour depressants while also being excellent viscosity index improvers.

The viscosity index-improving characteristics of these pour depressant polymers are very nearly as good as for the polymers preferred for this purpose alone. It is thus possible to obtain either part or all of the desired viscosity index improvement using the pour depressant polymers and to secure the low pours essential for winter service. An outstanding characteristic of this polymeric pour depressant is the stability of the depressed pour point under various temperature cycles as well as after severe service conditions.

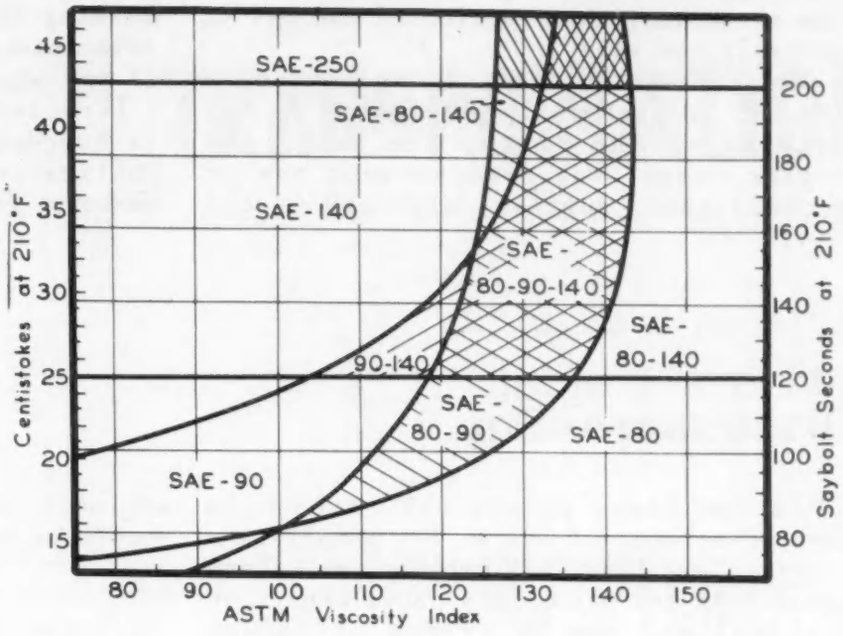
General procedure in preparing fluids having these improved viscosity-temperature characteristics has been to start with a base stock somewhat lighter in viscosity than desired for the final blend. This allows for the unavoidable thickening action of the polymer. Depending on the properties desired for the final fluid, the polymer may contribute only a small part of the viscosity of the blend, or as in the case of aircraft hydraulic fluids, may furnish the major part of the final viscosity.

Of course more polymer is required to bring low viscosity index oils into the double-branding ranges, so that these stocks are not as suitable for preparing the very high viscosity index grades - such as SAE-10W-30 - but may be suitable for the SAE 20W-30 grade. Such excellent V.I. improvement is obtainable even with very low V.I. oils that this may be a desired treatment of such stocks.

Light oils having viscosity index values of 90 or above appear to be best for preparing the SAE 10W-20 or SAE



● Fig. 1 - Viscosity index requirements for combining SAE motor oil grades, as determined by straight-line extrapolation on ASTM chart D341-41



● Fig. 2 - Viscosity index requirements for combining SAE gear oil grades, as determined by straight-line extrapolation on ASTM chart D341-41

10W-30 grades; with these, the addition of sufficient polymer to produce the desired V.I. gain does not thicken the oil beyond the SAE 10W viscosity limit at OF.

When used under what might be called typical driving conditions, the polymer has a sort of viscosity stabilizing effect. The thickening of the oil, as a result of oxidation, is compensated in part by the viscosity decrease from mechanical working of the polymer.

Presence of these polymers in a motor oil appears to cause no unusual effect as far as oxidation stability of the oil blend is concerned. These materials, being polymeric esters, are relatively inert. They cannot readily be hydrolyzed and are apparently less susceptible to oxidation than petroleum oils. Oxidation and bearing corrosion tests - on Underwood machines and by modified Indiana type oxidation tests - have shown that the various commercial oxidation-bearing corrosion inhibitors function the same when the polymers are present in the blend as with only the base oil.

WHAT TESTS SHOW

Engine tests are perhaps of greatest interest for evaluating motor oils and a number of 36-hr type L-4 Chevrolet engine tests as well as hundreds of thousands of miles of road tests have been made on these polymer-containing high viscosity index oils using several base stocks. It was found that, with a given set of test conditions, the final engine rating was determined by the grade of oil stock and the inhibitors used rather than by the presence of the polymers.

Such engine tests are usually made to determine the condition of the engine after using a given oil, but for the polymer in oil blends the effects of the engine test on the oil are perhaps of greater interest. Since the polymers are added primarily for their effect on viscosity and pour point of the oil, the changes in these properties reflect the behavior of the polymer. In an engine test, changes in viscosity of these high viscosity index test oils can result from oxidation of the oil, (which usually causes thickening of the blend) or from deterioration of the polymer either from oxidation or mechanical breakdown.

It is difficult to separate these effects directly. But by comparison of oxidation tests made on the base stocks as well as on the polymer blends, and by comparing the effects of adding fresh polymer to partially oxidized oils, it was found that oxidation of the polymethacrylates was of less importance than oxidation of the base oil or of mechanical depolymerization of high molecular weight polymers. Oxidation of the oil during an engine test can be minimized by

avoiding unusually high temperatures; yet the mechanical shear action of the oil is probably the same.

The shearing action of the engine on the oil is presumably determined by the fitting of the parts, the load, and engine speed. But even various new or reconditioned engines, although of the same model, may have slightly different bearing or piston clearances, which may have considerable effect on the intensity of the shearing action.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Discussers Say. . . . .

"As Van Horne points out, such oils have advantages of easier low temperature starting and lower oil consumption. These advantages are not merely paper ones, but are real and can be proved by actual test.

"Also, as he points out, they permit double branding, thus allowing a smaller number of grades to be stocked. In the oils mentioned, four grades cover the range from 10W to SAE 70."

C. W. Bohmer, Jr.
Standard Oil Co. of New Jersey

"At first glance these oils appear to offer a remarkable advantage to the marketer and user of such blends. Careful analysis of the problem, however, indicates that the customer does not gain much.

"The reason for this is that atmospheric changes are not usually abrupt enough to require the use of different SAE viscosities within a short period of time. Since he must change the oil in the crankcase to get rid of moisture, soot, and other contaminants several times during a given season, he can just as well shift to the proper viscosity at that time.

"The marketer has other problems - such as distribution, inventories, and handling facilities - which might be reduced appreciably in case double branding is adopted. Such advantages have to be calculated with the conclusion that the marketer cannot afford to pay much for the privilege of double branding. It should not be concluded, however, that this is universally true, since undoubtedly there are many localities where V.I. improvers should be worth more than their cost."

J. C. Geniesse
Atlantic Refining Co.

"Since petroleum base oils of 140 V.I. can now be made, refiners may find it desirable to devote attention to better dewaxing and to use of improved pour point depressants. In this way the high viscosity index properties can be coupled with pour points in the range of -20F to -35F and lower. Such a product should go a long way toward solving many low temperature problems with automotive equipment in cold climates.

"Oils containing polymers should also contain effective oxidation inhibitors. Otherwise, oxidation of the polymer may occur and may lead to loss in viscosity and viscosity index, as well as to production of undesirable oxidation products.

"Good oxidation inhibitors are needed to insure that the petroleum base stocks, into which the polymer is dissolved, have the required oxidation stability and cleanliness. Since most polymeric additives usually do not greatly affect the oxidation and cleanliness characteristics of the oil, the refiner can normally use the types of inhibitors best suited for his stock.

"There are certain instances where an optimum proportion of bright stock has been incorporated in oils to disperse better oil insolubles and to provide greater engine cleanliness. Since polymer usually displaces bright stock, such compositions may have to be re-examined."

M. R. Fenske
The Pennsylvania State College

FUTURE Commercial Highway TRANSPORTATION

BASED ON PAPER* BY

John S. Worley
University of Michigan

COMMERCIAL highway transportation will continue to grow at a rate probably greater than that of any other type.

Although present volume of highway freight ton-miles is less than 10% of the nation's total, commercial transportation is an absolute essential to our domestic economy.

Nothing indicates that motor vehicle transportation will replace any other form of transport. Neither can any other form render the service which motor vehicles give to the public.

The public is not obtaining the full service of its highways because limitations of sizes and weights have been established without rhyme or reason. A most casual comparison of the various states' heterogenous regulations support this conclusion. Trade barriers serve no public purpose.

Public officials who should be most interested in seeing that the public receives the maximum service seem the least concerned. We are greatly in need of public servants whose ambition is public service.

Among changes which may be expected in the design of our highways of the future are:

- Sharp curves will be replaced by longer radii to permit higher speeds,
- Grades will be reduced,
- Sight distances will be increased,
- Lane widths will be increased and more lanes added, and
- More adequate exit and entrances to urban areas will be provided.

There will be no revolutionary changes in our highway system. This will be improved through the evolutionary process under pressure of the needs of our domestic economy.

Volume of vehicles, safe speed, weight limits, and cross sections measure road capacities.

A 20 ft roadway, with average curvatures and grades, will handle peak loads up to 4000 vehicles a day. Four lane highways will take 12,000 to 18,000 a day. The period of daily peak affects the carrying capacity of any rural road.

Excepting entrances into and near larger cities, traffic volume seldom is more than a fraction of a road's capacity, or a road's saturation point. This can be solved by an additional lane.

In general, intercity and rural highways, and many miles of city streets have a much greater capacity than is now being used.

Paving surfaces and bridges must be considered separately in determining load limits. Eleven percent of total highway construction cost in Michigan since 1910 was for bridges.

Although the maximum weight carrying capacity of paving surfaces is not known, axle loads of 18,000 lb are permitted in 42 states. Only three require less loading on secondary roads, and three specify

*Paper "Future Commercial Highway Transportation" was presented June 8, 1948, at the SAE Summer Meeting, French Lick, Ind.

Highway Transportation And Michigan's Economy

58% of vehicles built in the state are shipped by auto haulaways.

More than one-half of the furniture, drugs, and paper made in the state is shipped by motor transport;

More than 75% of the cement produced in Lower Peninsula is moved over the highways;

Thirty-five to 50 trucks move daily in and out of the Dow Chemical plant at Midland;

More than 5,000,000 lb of salt are trucked from Diamond Crystal's St. Clair plant;

One-third of the state's potato crop, nearly half the apples, more than half the tomatoes, and three-quarters of peaches and grapes harvested are shipped by truck;

Some 5,000,000 crates of fruit from the Benton Harbor area are shipped annually by truck to 28 states;

All of the 1947 cherry crop and all of the state's sugar beet harvest is trucked from farms to canneries and refineries, and half of the sugar is moved over highways;

Trucks handle 97% of the state's hogs, 90% of calves, 81% of its cattle, 76% of its sheep, and practically all of its $120,000,000 dairy products;

Highways carry 60% of petroleum products used in the state, and the marquette and Goberic open pit iron mines are served exclusively by trucks;

Trucking reduce retail inventories and supply the state's motor vehicle industry with components from throughout the state and from Ohio, Illinois, Indiana, and other nearby states.

The same is true for many of the states of our union.

maximum axle loads below 18,000 lb. Nine allow loads above 18,000 lb, ranging from 19,000 to 22,400 lb, and five states have no limit.

It is quite evident that an 18,000 lb axle load is not the maximum which can be carried by any class of paving surfaces, from dirt to the most expensive type. The support of loads is in the subgrade and not in the paving surface. However, earth, gravel, and thin paving surfaces fail during spring thaws due to poor construction. But this class of road is little used by heavily laden commercial vehicles.

Allowable gross loads on bridges could be greatly increased without danger, but loadings should not be increased without careful inspection of the structures. In bridge design factors of safety of from 200 to 400% are used, and occasional overloads of 50% could be carried without causing undue overstresses.

Although there is some uniformity among states as to length, width, height, gross load and axle load of vehicles, the variation is large.

The American Association of State Highway Officials has adopted these "Compromise" standards:

Width	
Present	96 in.
Future	102 in.
Height	12.5 ft.
Length	
Single truck	35 ft.
Truck-tractor and semi-trailer	50 ft.
Truck and full trailer	60 ft.
Permissible load	
Single axle	18,000 lb.
Tandem axle	32,000 lb.

It is to be expected that a width of 102 in. will ultimately be the adopted standard. This will permit greater stability of vehicle and permit the providing of vehicles with better brakes.

Heights will not be increased in the immediate future, and the lengths appear reasonable.

Despite the fact that in the five northwestern states there are hundreds of

CONTINUED ON PAGE 59

What the Air Force Wants in NONFLAMMABLE Hydraulic Fluids

Specifications for nonflammable hydraulic fluids is one of the major projects of the SAE Aircraft Hydraulic and Pneumatic Equipment Committee. Glass here synthesizes talks he has given at recent meetings of the Committee.

Says Committee Chairman B. R. Teree, The Weatherhead Co., of this article, "very worthwhile and interesting to aircraft manufacturers, equipment manufacturers and airline operators. Contents will be very useful for the chemical industry to follow in developing less flammable hydraulic fluids."

A SUMMARY OF DISCUSSION* BY

E. M. Glass

Chief, Petroleum Products Unit
Materials Laboratory, Engineering Division
Air Materiel Command

CONSIDERABLE attention has been given within the past year to the need for a less inflammable hydraulic fluid for commercial and military aircraft. As a result of several aircraft fires which have been directly or indirectly attributed to the petroleum base hydraulic fluids, such as Air Force-Navy Aeronautical Specification AN-O-366, used in present commercial aircraft, considerable pressure has been brought to bear upon the commercial airlines and aircraft manufacturers to institute as soon as possible the use of less inflammable fluids in aircraft hydraulic systems.

The intervening period has seen the development of several formulations which have been the subject of detailed evaluation by the military services, the aircraft manufacturers and the airlines. Several specifications have been written also to describe less inflammable hydraulic fluids for aircraft use, (a) Navy Specification 51-F-22 (Aer), which covers a water-ethylene glycol base fluid, commonly referred to as "Hydrolube", and (b) SAE Aircraft Materials Specification (AMS) 3150, which describes an interim fluid for commercial aircraft required to be compatible with present hydraulic system materials and fluids. This specifica-

*Opinions expressed are those of the author and do not necessarily represent official opinions of the Air Materiel Command.

tion was formerly distributed as the Aircraft Industries Association Proposed Specification for Non-Flammable Type Hydraulic Fluid.

The trend in all fluids developed to date has been to sacrifice performance of the fluids to achieve varying degrees of improved flammability characteristics. The attitude of the Air Force has been that none of the performance requirements of the present Specification AN-O-366 can be compromised without impairing the efficiency of a global Air Force. These differences in overall requirements may well see the use of different hydraulic fluids by commercial and Air Force aircraft—a truly regrettable incident.

The insistence of the Air Force that there be no compromise with performance in any less flammable fluid adopted for its use has resulted in a wide-spread and erroneous impression that the Air Force is not interested in a less flammable hydraulic fluid. The intent here is to allay such impressions and to outline the minimum requirements for a less flammable fluid, which is acceptable to the U. S. Air Force.

Interest in less inflammable hydraulic fluids by the United States Air Force dates back to approximately 1943, and was motivated by a British survey which concluded that 2 to 3% of all aircraft lost as a result of fires in combat were lost as a result of hydraulic fluid fires. While this number could probably have been reduced markedly with proper design changes, the problem was considered sufficiently important by the Air Force to warrant the initiation of a "fire-proof" fluid program with the National Defense Research Council, under the direction of Dr. M. R. Fenske.

This program was established to determine the feasibility of preparing less flammable, aircraft hydraulic fluids which would not result in significant sacrifices in performance.

In 1945, when a Joint Air Force-Navy Bureau of Ordnance contract displaced the NDRC contract, this work was continued. The investigation has covered the evaluation of the following classes of materialsowhich appeared to offer some merit as base stocks for less flammable hydraulic fluids and lubricants: water-glycol mixtures, tri-alkyl phosphate esters, boric acid esters, organic alkyl carbonates, dibasic acid esters, and various halogenated materials.

Within the past year, however, greater emphasis had been placed on the development of "snuffer" type additives for incorporation into petroleum base fluids. It was felt that the task of preparing a less flammable AN-O-366 fluid would be infinitely simplified if it were possible to add less flammable additives to the present petroleum base hydraulic fluids to arrive at the desired end product.

Work along these lines has been continuing for some time at both the Petroleum Refining Laboratory, the Pennsylvania State College, and the Materials Laboratory, Air Materiel Command with very promising results. It has been possible to prepare several formulations with the use of halogenated "snuffers" which meet practically all flammability requirements of AMS Specification 3150 and the performance requirements of Specification AN-O-366.

The materials used to date to prepare these formulations are not readily available and are extremely costly compared with costs of petroleum base fluids; however, it has been shown that with the use of these materials, a suitable less flammable fluid appears possible. It is felt that a reasonable specification can be prepared so that the Petroleum and Chemical Industries will have some indication of what has been possible in the laboratory.

The minimum requirements and the need for such requirements are listed below. These requirements are being incorporated into an Experimental Air Force Specification covering a less flammable hydraulic fluid.[1]

•*Viscosity Requirements* - Viscosity is considered to be one of the most important requirements for aircraft hydraulic fluids. From the viewpoint of lubrication at high temperatures, the highest possible level of viscosity must be maintained

[1] The requirements outlined in this paper are only tentative and are subject to considerable change as a result of new findings.

if long time, satisfactory operation of hydraulic mechanisms is to be realized. Maintaining a relatively high level of viscosity at higher temperatures is also mandatory from the viewpoint of both internal and external leakage. Maintaining the viscosity of the fluid as low as possible at extremely low temperatures is vital from the viewpoint of low temperature operation.

Any hydraulic fluid acceptable to the USAF must allow for satisfactory operation from −65F to +160F, ambient. On the basis of tests conducted by the Air Materiel Command, it is indicated that the +130F and the −40F viscosities of Specification AN-O-366 must be satisfied. Since volume flow and leakage are more a function of absolute viscosity, the viscosity requirements for the specification will be based on centipoises. The minimum viscosity at +130F will be 9 centipoises, and the maximum at −40F will be 500 centipoises.

•*Pour Point* - The pour point of the fluid will be the same as required for Specification AN-O-366. The pour point requirement of −75F is specified to guarantee low temperature fluidity below −40F.

•*Cloud Point* - The separation from the fluid of large amounts of insoluble materials, such as polymers, additives, and so forth, should not take place above the lowest temperature at which the fluid is intended for use; otherwise, clogging of filters, sticking of valves and other critical parts of a hydraulic system may result. The present low temperature stability test (at −65F) will be adhered to.

•*Precipitation and Neutralization Numbers* - Requirements for precipitation number and neutralization number will be established as quality control measures. These requirements will be similar to those required in the present petroleum base hydraulic fluid specification.

•*Corrosion and Oxidation Stability* - Experience with hydraulic fluids under service conditions indicates that they are subject to oxidation and other types of chemical changes which lead to marked changes in fluid properties. Such phenomena usually occur when a fluid is in intimate contact with active metal surfaces at relatively high temperatures. As a result, the fluid properties are altered to such a degree that the resultant product will no longer be satisfactory for the application involved. The corrosion and oxidation stability requirements of Specification AN-O-366 have adequately controlled this property of presently-used hydraulic fluids and these requirements will be maintained in the proposed specification.

•*Hydrolysis* - Many of the non-hydrocarbon materials previously suggested for use in hydraulic fluids are subject to hydrolysis. A requirement will be established to control the hydrolysis stability of fluids submitted under the proposed specification.

•*Shear Stability* - It is a foregone conclusion that any fluid which meets the viscosity-temperature requirements of the proposed specification will require the use of polymeric "V.I." improvers, at least for the time being. A shear stability test of the type described in Specification AN-O-366 will be used to insure that the "V.I." improvers used will not exhibit unusual permanent losses in viscosity when pumped for long periods of time under prescribed conditions through a simulated hydraulic system.

•*Rubber Swell* - The compatibility of any hydraulic fluid with the rubber components used in hydraulic systems must be maintained if satisfactory performance is to be achieved. In the past, it has been the responsibility of the hydraulic fluid manufacturers to maintain control over hydraulic fluids with respect to their effect on unplasticized elastomers of the type used to formulate hydraulic system components. Every attempt will be made to continue this rigid control over newly developed fluids in order that a complete change in rubber formulations will not be required.

In the event that this appears impossible, however, consideration will be given to the development of rubber compounds more compatible with a fluid determined to be suitable in other respects. For the present time, the maximum swelling of Standard Test Rubbers H (Hycar OR-25) and L (Perbunan 18) will be slightly in excess of the present requirements.

The minimum requirements for swell will not be changed.

•*Wear and Lubrication* - With the need for long life of aircraft hydraulic pumps in service, it must be required that the lubrication properties of any proposed fluid equal that obtained with the present petroleum base hydraulic fluid. This property will be controlled by determining wear of pump parts after cycling the fluid through a simulated hydraulic system under the following conditions:

Pressure	—	3000 psi
Temperature	—	200F
Time	—	100 hr

•*Compatibility with Petroleum Base Hydraulic Fluids* - If the Air Force must change hydraulic fluids, it must be accomplished with a minimum amount of confusion and man hours expended. Experience derived from the change-over from a castor oil base fluid to a petroleum base fluid has indicated the unusual difficulties involved in the replacement under field conditions of incompatible fluids. Accordingly, a requirement will be included to require that any proposed fluid be soluble in all proportions with Specification AN-O-366 fluids from −65F to +160F.

•*Volatility* - Heretofore, flash point was used to measure the volatility characteristics of petroleum base hydraulic fluids; however, this will be impossible with the less inflammable fluids as they will have either extremely high flash points or no flash points. The requirement for the proposed fluid will be that the volatility be no greater than that exhibited by Specification AN-O-366 Fluids containing low boiling "snuffers" would offer a false sense of security as the flammability characteristics would be continually worsened during long periods of operation at high temperatures (that is +150 F to +200 F) and as such must be disqualified.

•*Flammability Tests* - In general, the flammability tests follow those established by the Aircraft Research and Testing Committee, Subcommittee on Non-Flammable Hydraulic Fluids, which is under the jurisdiction of the Aircraft Industries Association. The exceptions are that a gun-fire test has been included and the wick tests eliminated.

•*Spontaneous Ignition Temperature* - While there is in general very little correlation between this test and flammability characteristics, the spontaneous ignition temperature test, in addition to others required, may give a better insight as to the inflammability characteristics of a fluid. The requirement will be that the fluid shall not ignite spontaneously below 1000F. This is more severe than that required by AMS Specification 3150. No fluid will be rejected solely on the basis of this test.

•*Oxygen Demand* - This test has been established as a simple laboratory test which has general correlation with gun-fire tests according to work conducted by the Naval Research Laboratory (see paper entitled, "Flammability of the Higher Boiling Liquids and their Mists")[2]. This test is being used to aid potential suppliers to screen possible base stocks prior to submission and test by the Air Materiel Command. All fluids submitted will be subjected to actual gun-fire tests, a test which fluid suppliers need not conduct. The percentage oxygen required for flame propagation will be limited to a minimum of 50% for any proposed fluid. This is in line with a possible revision to the AMS specification.

•*General Flammability Tests* - The general flammability tests of the AMS specification 3150, with the exception of the wick tests have been adopted for the proposed USAF specification.

•*Gun-Fire Tests* - In addition to the previous flammability tests mentioned, fluids being evaluated will be subjected to a .50 calibre incendiary bullet gun-fire test. Potential suppliers will not be required to conduct this test, but will be allowed to use the oxygen demand test to screen potential base stocks.

•*Toxicity* - The task of defining toxicity is admittedly a difficult one and one that will always be subject to considerable criticism as toxicology studies on Specification AN-O-366 fluids indicate that

[2]Ind. & Eng. Chem., Vol. 39, P. 607, Dec. 1947.

even these petroleum base fluids have caused some dermatological effects on hydraulic system maintenance personnel. A general statement of toxicity such as is included in AMS specification 3150 will be incorporated into the specification, although detailed toxicology studies are anticipated prior to the approval of less flammable fluids containing known toxic materials. Additional work will also be required in the case of materials whose toxicity has not been too well established.

To summarize, the Air Force has maintained a sincere and continual interest in the development of a less flammable hydraulic fluid consistent with the performance requirements established by Specification AN-O-366. An experimental Air Force Specification covering such a fluid is being prepared at the present time to establish a practical objective towards which the petroleum and chemical industries may direct their research.

With the aid of these industries, heretofore always capable of arriving at solutions to problems encountered by the military services, it is felt that suitable formulations, comprising low cost and readily available materials, will be developed—another step forward in the never-ending battle to eliminate real and potential hazards in aircraft, military and commercial.

Future Transportation

CONTINUED FROM PAGE 54

miles of private logging roads which handle hundreds of loads daily ranging from 150,000 to 400,000 lb, the AASHO recommends allowable gross loads, varying with the length of vehicle combination of only 63,892 lb for a truck tractor semitrailer, 50 ft in length and 44 ft between extreme axles, and for 60-ft combinations 71,202 lb.

Gross loads of 110,000 lb are permitted in Michigan for all types of roads except during the spring thaws. Many of these roads have steel truss bridges of the vintage of 1880 to 1890. Few failures are reported. Operation of nine axle combinations is permitted in 16 of our 48 States.

Of the 1489 trade barriers in various states, 301 apply to motor vehicles. Safety, highway preservation, and compensation for use are reasons for these laws.

Study of current specifications set for vehicles by the various states discloses that many of the differences which exist among a large majority of the states are very small, and that the free movement of vehicles over their highways would in no way be an increased traffic hazard or destructive of the paving surfaces.

So little public benefit comes from trade barriers that it might be said that they were conceived, born, and operated for evil motives. Their establishment leads to retaliation, breeds ill will among states and threatens interstate commerce of modern industries.

The remedy which is most acceptable would be the adoption by the states of a uniform code or granting full reciprocity. It appears that there is little likelihood of this occurring.

The remaining remedy is for the adoption of uniform specifications for vehicles and loadings by the federal government for vehicles engaged in interstate commerce. That the federal government has full power in this matter seems to be of little question.

(Complete paper on which this article is based is available in full from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Polarized Headlighting fo

THE automotive industry, with the cooperation of the Polaroid Corp. and the General Electric Co., has recently completed a thorough-going investigation and analysis of polarized headlighting as a possible answer to the problem of seeing without glare. The consensus was that the polarized headlighting system developed through this cooperative activity did provide adequate visibility without glare. The seeing, when facing an approaching car with polarized headlamps, is almost equal to that when the road is clear, and the glare annoyance with this system is considerably less than that when facing a present-day lower beam.

Of interest is a comparison of seeing distances with present headlighting and with polarized headlighting. Over a period of years we have made a great number of field measurements using observer-drivers with the object of establishing relations between candlepower and visibility distances, considering such factors as glare, speed, obstacle reflection factor, and driver attention.

The most critical hazard from the standpoint of seeing is a pedestrian dressed in dark clothing. An observer-driver, knowingly engaged in a test, and using the Sealed Beam upper beam, can see the pedestrian in dark clothing at 500 ft when driving 40 mph. Tests on a large number of observer drivers show an attention factor of 0.5. That is, we have found on the average that clear road drivers, who are unaware that they are likely to encounter an obstacle on the road, see it only half as far away as when they know they are engaged in such a test.

Applying this attention factor of 0.5 to the 500-ft measurement, we obtain a seeing distance of 250 ft for a pedestrian in dark clothing and with the Sealed Beam upper beam on the clear road. Applying the legally-accepted deceleration rate of 14.5 ft per sec per sec plus 3/4 sec reaction time for stops from speeds of 20 to 40 mph, we arrive at a stopping distance of 165 ft. Therefore, with a Sealed Beam upper beam on the clear road, the 250-ft seeing distance provides a margin of 85 ft beyond the stopping distance at 40 mph.

SEEING RANGE SHORTENED

When meeting other vehicles, the seeing distance is reduced by the glare from the approaching lamps. Considering the condition of a Sealed Beam upper beam facing another Sealed Beam upper beam, when the two cars are 3200 ft apart, the clear road seeing distance is reduced 40%. The 500-ft figure is reduced to 300 ft.

A fair estimate of the attention factor for the condition of meeting other vehicles might place it at about 0.7. Therefore, considering the condition of two cars with Sealed Beam upper beams, 3200 ft apart, if we apply a factor of 0.7 to the 300-ft seeing distance value (for the observer-driver knowingly engaged in a test), we arrive at a seeing distance of 210 ft. This still gives a margin of 45 ft above the stopping distance value at 40 mph.

As the two cars continue to approach,

for Cars

EXCERPTS FROM PAPER* BY

Val J. Roper

General Electric Co.

the seeing distance drops because the effect of glare becomes worse. Our tests show that when they are 1200 ft apart on a straight road, the seeing distance has dropped to a value which equals that for the lower beams of Sealed Beam headlamps. This, therefore, is the optimum distance for depressing the beams.

Even with the proper usage of Sealed Beam lamps when meeting other vehicles, there are short periods when the seeing distance with that system is somewhat less than the stopping distance from 40 mph - considering the critical hazard of a pedestrian dressed in dark clothing. Of course, when drivers do not depress their beams, the situation is even worse because of the much more blinding glare from the upper beams.

With polarized headlighting of the type developed cooperatively, the clear road seeing distance looking through the analyzer (for the observer driver knowingly engaged in a test) is the same as that for the Sealed Beam upper beam - 500 ft for the dark obstacle. When meeting another polarized car on a straight, level road, our tests show that the seeing distance drops only about 50 ft below the clear road values - to 450 ft.

If we apply the estimated attention factor of 0.7, this becomes 315 ft and provides a margin of 150 ft beyond the distance needed for stopping. And this 315-ft seeing distance and the 150-ft margin continue to apply until the two cars meet and pass.

To obtain a comparison of seeing distances with polarized headlamps and with Sealed Beam headlamps during a transition period following an introduction of polarized headlighting, we investigated a number of different combinations which would be encountered. Resulting visibility distances for conditions of proper usage are charted in Fig. 1.

If it is desired to provide "headlighting with minimum glare," the answer seems to be the use of polarized headlighting. However, polarized headlighting has been carefully considered by the automotive industry which has recommended against its adoption "at this time" for many reasons. I believe these many reasons can be boiled down to three major factors:

1. Cost.
2. Hazard of confusion and complaint during long transition period with mixed driving conditions.
3. Nuisance of viewing the road through an analyzer.

I believe we all can agree that the most serious problem in connection with a decision on the use of polarized headlighting is that of the 34 million vehicles now on the roads. If the legal authorities wish to permit the use of a standard, low-cost auxiliary system for voluntary installation by present owners, some percentage of present cars, trucks, and buses could be equipped, increasing the incidence of polarized meetings.

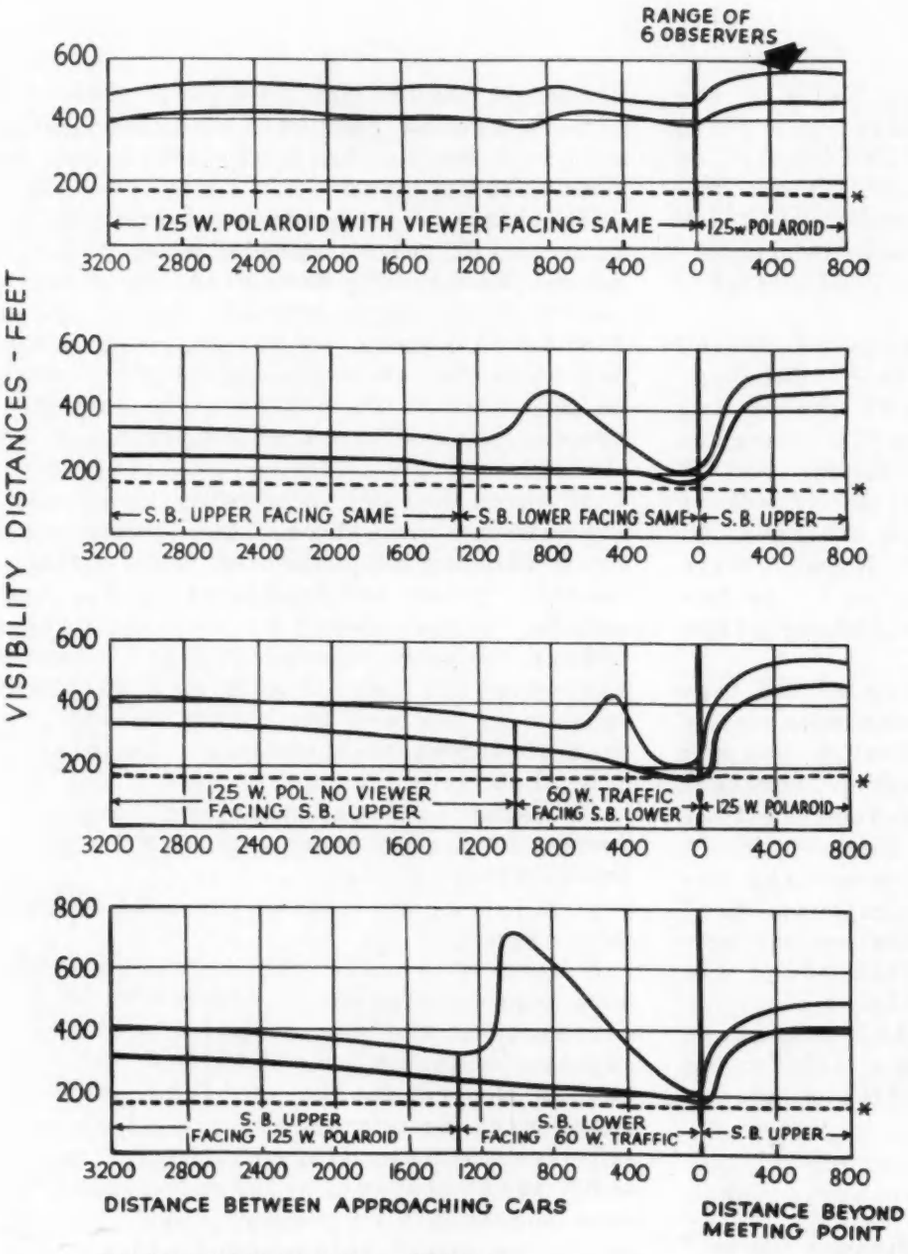
Assuming that there were few - if any - cars with pre-Sealed Beam headlamps on

*Paper "Headlighting with Minimum Glare," was presented at SAE National Passenger Car & Production Meeting, Detroit, March 4, 1948.

the road at the time of introduction of polarized headlighting, these test results lead to a general conclusion that the range of seeing distances during the transition to polarized headlighting would be no greater than the range of seeing distances encountered during the present period of transition from pre-Sealed Beam to Sealed Beam headlighting. And the driver of the polarized car would enjoy somewhat higher seeing distances (without the analyzer) even during the early stages of the transition period.

However, the annoyance when facing the polarized upper beam without an analyzer would be greater than that when facing the present Sealed Beam upper beam.

This leads to a justified fear on the part of the automotive industry that the greater annoyance to drivers without


RANGE OF 6 OBSERVERS
VISIBILITY DISTANCES - FEET
600
400
200
125 W. POLAROID WITH VIEWER FACING SAME
125w POLAROID
S.B. UPPER FACING SAME
S.B. LOWER FACING SAME
S.B. UPPER
125 W. POL. NO VIEWER FACING S.B. UPPER
60 W. TRAFFIC FACING S.B. LOWER
125 W. POLAROID
800
S.B. UPPER FACING 125 W. POLAROID
S.B. LOWER FACING 60 W. TRAFFIC
S.B. UPPER
3200 2800 2400 2000 1600 1200 800 400 0 400 800
DISTANCE BETWEEN APPROACHING CARS
DISTANCE BEYOND MEETING POINT
* STOPPING DISTANCE - 165 FEET
DECELERATION - 14.5 FT./SEC.²
PLUS 3/4 SEC. REACTION TIME

● Fig. 1 - Driver visibility distances for various combinations of polarized and Sealed Beam headlights, assuming proper headlamp usage. Obstacle in these tests was a man-sized dummy in dark clothing, with cars traveling at 40 mph

polarized headlamps when facing drivers with polarized headlamps, who don't shift, might cause a public reaction against polarized headlighting which could lead to restrictive legislation. (Paper "Headlighting with Minimum Glare," was presented at SAE National Passenger Car and Production Meeting, Detroit, March 4, 1948. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Discussion

by John B. Dickson

Chrysler Corp

Mr. Roper has boiled down three major factors which influenced the automotive industry's recommendation against the adoption of polarized headlighting at this time. It is interesting to note that all three of these are related to a single factor - the inherent low efficiency of polarizing materials.

A theoretically perfect polarizer of the type which absorbs the extraordinary ray would be 50% efficient. Actually the material used in developing the polarized headlight system is about 40% efficient. The light must pass through polarizers as it emerges from the headlamps and the driver must view the road through another polarizer or analyzer, which is also inefficient, if he expects to extinguish the glare from other polarized headlamps facing him on the highway.

It has been demonstrated that a 125-watt filament is needed in each polarized headlamp to maintain seeing ability on the road to that now obtained from a 45-watt Sealed Beam unit. While driving within corporate limits and for passing cars with unpolarized lights a second pair of lower wattage, unpolarized lamps is necessary.

The three factors referred to above are now nearly self-evident.

1. The cost of the four headlamps plus larger generator, heavier wiring and adjustable viewing screen involves a considerable penalty over the units required for the present lighting system; and there would be no offsetting advantage to the owner, who must absorb the cost, during the early stages of the transition period.

2. The transition period would last until most of the "old" cars, already on the road, become worn out.

3. The 40% efficient analyzer when in use reduces the effect of all extraneous lighting including traffic lights and tail lights. The effect, while mainly psychological, may also prove hazardous.

In attempting to balance the three factors against expected benefits, a survey of state accident records has been made. The results are:

1. Accident records in 31 states do not classify headlamp glare as a cause worthy of separate consideration.

2. Records of rural, night-time accidents in the remaining 17 states mention glare as a contributing factor in 29 out of each 1000 accidents. Three of the 29 show glare to be the sole cause.

The spokesman for the automotive industry summarizes these statistics as indicating that headlamp glare may be an emotional problem rather than an actual driving hazard.

Another factor which should not be overlooked is our modern trend toward divided highways. This may prove to be the real solution to the glare problem and, simultaneously, an effective means of reducing the number of accidents due to other causes. Many years and huge investments will be required to change over all highways, but the beneficial results have been demonstrated and the trend is under way.

Thus headlight glare is recognized as a problem and plane polarized light is recognized as one possible solution. The automotive industry decided in favor of postponement rather than immediate application of this solution.

Discussion

By J. H. Hunt
Secretary,
AMA Engineering Liaison Committee

The Engineering Liaison Committee of the Automobile Manufacturers Association started its investigation of polarized headlighting because preliminary demonstrations had shown that seeing conditions while cars using polarized headlighting are meeting at night should be substantially those given in Mr. Roper's tests. Mr. Roper is to be complimented on his extensive tests which deserve very careful consideration. These tests were limited to a type of roadway which is not representative of the great majority of highway mileage. It is, however, probably impossible to duplicate the tests on representative samples of all types of highways. The roads could not be reserved for such tests over the required time, to say nothing of the expense. This situation must be kept in mind in interpreting the results.

The Engineering Liaison Committee faced several requirements in developing the sample polarized light installations used in these tests. Driver seeing with the polarized lights and the polarized viewer in use, must be equal to Sealed Beam. The components must be in such a form that they can be installed on commercially produced vehicles. Reliability in operation equal to present equipment is necessary. A practical plan for the possible introduction of the system to public use must be developed which is acceptable to the motor vehicle officials and to the public.

The Engineering Liaison Committee report to the administrators who had requested the investigation included the following:

Demonstrations of performance on a wide range of road conditions.

Installation of the system was shown on nearly all models of current production cars of standard size. This included a pair of polarized headlamps, a pair of city driving lamps, which must also be country meeting lamps while present equipment is still in use on old cars, a 70-amp generator for use with a 6-v battery, completely new headlamp wiring including relays, and polarized viewers. This resulted in a weight increase of approximately 26 lb. Manufacturers had estimated a necessary increase in the selling price of the vehicle of $30.00 to $80.00 if the system should be installed as standard equipment.

The Engineering Liaison Committee has been unable to develop a plan for introducing the system which seems satisfactory. A long period would be unavoidable, during which both polarized and present headlighting would be on the road. The driver of the polarized lights who failed to switch to the city lamps when meeting present lighting would cause great annoyance with some increase in danger. The driver of present lights who used a polarized viewer and his upper beam when meeting polarized lights would cause annoyance and danger to the driver of the polarized lights.

Past experience has shown that a certain percentage of drivers will continue to follow such bad practices. Difficulties foreseen with such obvious complications, plus uncertainties with respect to other questions still not fully explored seemed compelling to the Committee which has recommended against introducing polarized headlighting at the present time.

Mr. Roper has listed the increased cost as the first objection, and this might be assumed by some to be the principle reason for the unfavorable recommendation. This seems particularly possible because the critical attitude of the automobile manufacturer toward any cost increase is well known. In the ordinary case a contemplated increase of cost must be considered relative to a particular manufacturer's competitive position. If polarized lighting is introduced at all, it must go onto all new cars at the same time. This will not change the competitive position of any company.

Therefore, the ordinary cost influences did not apply when the Committee made its decision. The effect of this cost upon the public attitude must be considered, however, by any person or organization undertaking a program to secure legislation requiring polarized headlighting

Test Evaluates Effects of Volatility And Engine Variables on Warmup

BASED ON PAPER* BY **J. E. Taylor** Gulf Research & Development Co.
& **H. J. Gibson** Ethyl Corp.

(This paper will be published in full in SAE Quarterly Transactions.)

A test procedure for evaluating engine performance during warmup has been developed to help refiners formulate fuels for current engines and engine designers to develop engines relatively insensitive to volatility.

The procedure is to run the car at 20 mph, road load, and measure its performance at the end of each minute of operation until it is fully warmed up. Measure of car performance is the speed attained at the end of 6 sec of full-throttle operation, starting at 20 mph. Results are reported as plots of change in speed during acceleration versus elapsed time.

A refiner can get an idea of customer reaction to warmup ability of a proposed product by running it in various cars according to the test procedure.

An engine designer can use the procedure to study the effect of an engine modification on performance with fuels of various volatilities.

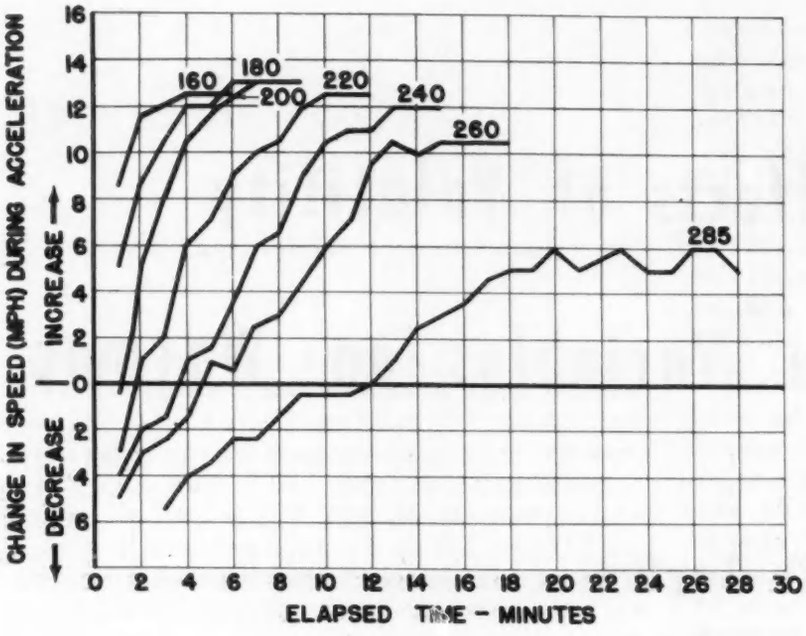
Reason for developing engines less sensitive to volatility is that there is likely to be a greater spread in volatilities of commercially available gasolines in the future. New refining processes make it economically desirable for many refiners to produce high-octane fuels of lower volatility. To meet the octane-number competition, refiners using older methods may be forced to continue the prewar trend toward increased volatility. An engine relatively insensitive to volatility will be able to use either type of fuel.

The fact that some engines tested according to the new procedure are relatively insensitive to fuel volatility shows that engine design can influence volatility response. The tests showed too that engine condition is a factor: Engines with dirty manifolds and inoperative manifold heat gave poorer warmup performance than engines with healthy manifolds.

*Paper "A New Approach to the Evaluation of Fuel Volatility and Associated Engine Variables," was presented at SAE Summer Meeting, French Lick, Ind., June 11, 1948.

TEST PROCEDURE

Starting with the engine at ambient temperature and test fuel in the fuel



•Fig. 1 - Warmup performance of Car A, manual choke, when operated on fuels of various volatilities. Ambient air temperature was 35 F

system of the test vehicle, the procedure is to:

1. Start the engine and bring the car speed to 20 mph, road load, as quickly as possible, accelerating normally through the gears. (On cars with a manual choke, the choke is placed in full-off position as soon as firing is regular.)
2. Operate the car at 20 mph, road load, in high gear for the remainder of 1 min after starting.
3. At the end of the first minute, accelerate the car at full throttle for 6 sec and record the speed attained at the end of the acceleration. (If the car has manual choke, acceleration is made with the choke completely off.)
4. Return the car to 20 mph road load and continue at this load and speed until another minute has elapsed. Then repeat the 6-sec acceleration.
5. Repeat the 1-min cycles until three successive accelerations give the same final speed, indicating fully warmed up performance.
6. Drain the test fuel, flush the fuel system with the next fuel, and run for a period long enough to ensure complete fuel change.

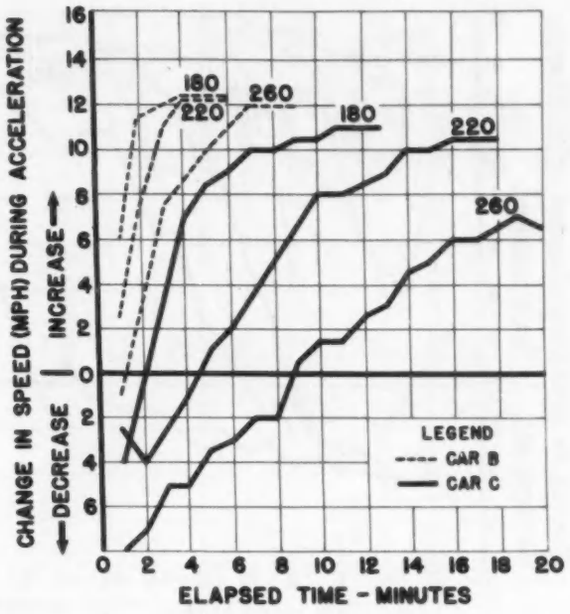
The procedure is well suited for use on a chassis dynamometer in a cold room where there can be accurate control of temperature, cooling air velocity, and car acceleration.

The dynamometers used during development of the test procedure were equipped with inertia and fan loading devices which closely reproduced road acceleration. Cooling was speeded up by circulating the jacket coolant from the engine through an external oil-water heat exchanger and back to the top of the radiator. Crankcase oil was pumped from a fitting in the drain hole through the heat exchanger and returned to the crankcase through the oil filler pipe. In this way, the fan blast cooled the jacket coolant flowing through the radiator. The jacket coolant, in turn, cooled the oil flowing through the heat exchanger. Engine temperatures were reduced to ambient in 30 min or less after a test run.

This quick cooldown permits a test each hour on the dynamometer. Cooling with fan blast alone on the dynamometer requires about 4 hr, permitting only two tests per day.

Aside from dynamometer controls, the procedure requires a device for timing the cycle and a speed indicator. A stop watch and car speedometer will suffice, but it is more convenient to use a cycle timer and a speed indicator more accurate, sensitive, and readable than the usual speedometer.

Road work gives reasonably satisfactory data, although variations in atmospheric temperature, grade, wind velocity and direction, and traffic congestion intro-



●Fig. 2 - Effect of fuel volatility on warmup performance of two cars equipped with manual chokes. Car B is relatively insensitive to fuel volatility. Car C is quite sensitive. Ambient air temperature was 35 F

duce inaccuracies. One run per day is a good rate with road tests because cooldown is so slow.

Fig. 1 illustrates the kind of data that can be obtained on the effect of fuel volatility on warmup performance of a particular vehicle. The numbers on the curves indicate the 50% evaporated temperature of the fuels - the 50% temperature being considered a good index of volatility. The 160 F fuel reached fully warmed up performance at the end of 4 min and gave smooth accelerations throughout the test cycle. The 180 and 200 F fuels required a few minutes longer to reach fully warmed up performance and were significantly poorer than the 160 F fuel during the first few minutes.

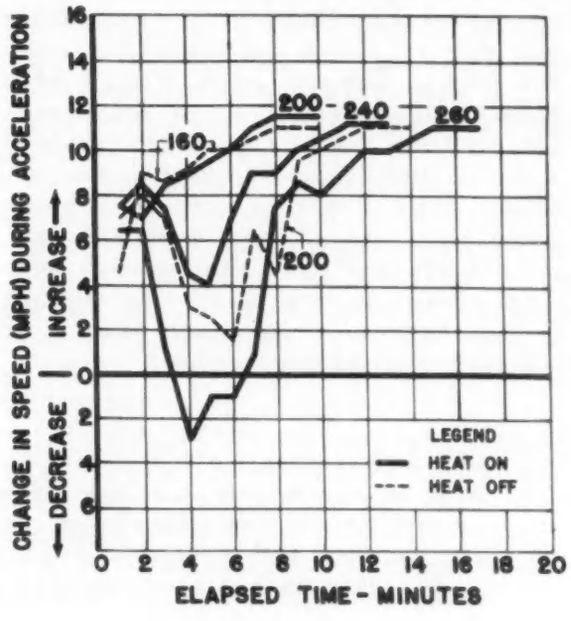
As volatility was decreased, the acceleration ability at any given time became progressively worse. A sharp decrease in fully warmed up performance occurred with the 260 F fuel. Operation on the 285 F fuel was never satisfactory.

In a number of test runs, it was found that extreme raggedness of the warmup curves accompanies poor engine operation. Smoothness of operation of any car during acceleration was related to the speed attained at the end of the acceleration period. As a general rule, smooth full-throttle acceleration was obtained whenever a car produced an increase in speed which was equal to 80% of the increase obtained under fully warmed up conditions with a volatile fuel such as the 180 F 50%-point test fuel.

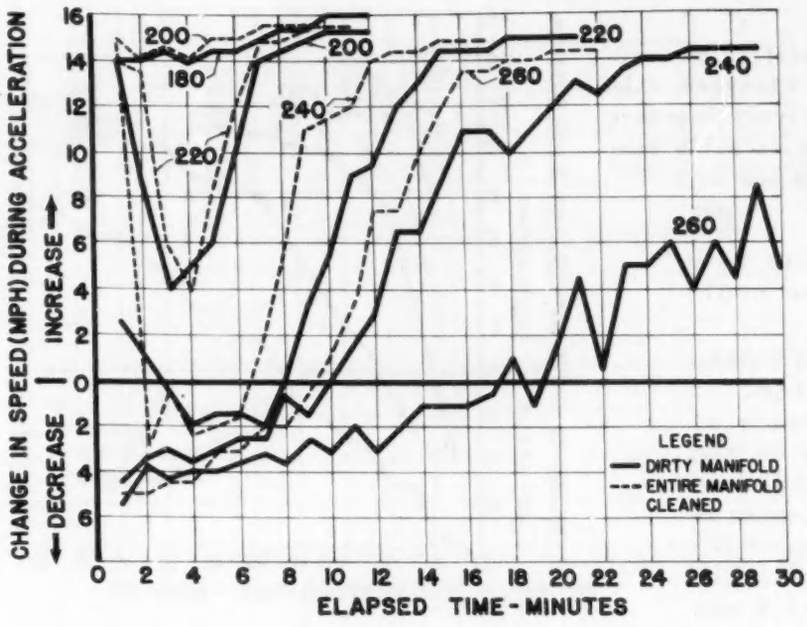
How much difference variations in engine design can make in sensitivity to volatility can be seen from Fig. 2, which presents data on two low-priced cars equipped with manual choke. At an ambient temperature of 35 F, Car B warmed up quickly on all three fuels, attaining fully warmed up performance on the 260 F fuel in 7 min and approximately the same final performance on all fuels. Car C required nearly three times as long to warm up on the 180 F fuel as did Car B. And Car C ran 9 min before it would accelerate at all on the 260 F fuel. Even after 20 min, acceleration ability was only about half that attained on the 180 F fuel.

Car C also exhibited poorer and poorer warmed up performance as volatility decreased.

Car C was also much more sensitive than Car B to change in ambient temperature.



●Fig. 3 - Effect of manifold heat on warmup performance of car equipped with automatic choke. Ambient air temperature was 35 F



● Fig. 4 - Improvement in warmup performance obtained by removing deposits from entire intake manifold. Car equipped with automatic choke. Ambient air temperature was 35 F

In general, tests showed that cars most sensitive to volatility are most sensitive to changes in temperature.

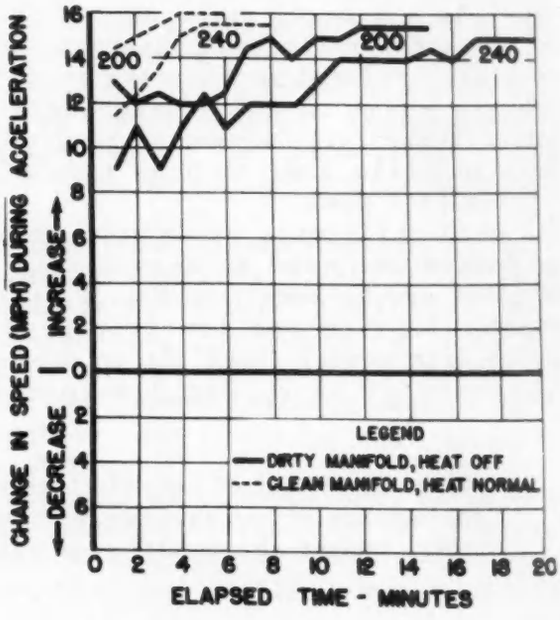
It was expected that engine temperature data would help explain differences in warmup performance of the various makes of cars tested. But analysis of hot spot, carburetor air, intake manifold branch, and jacket water temperatures did not substantiate the belief.

Basic engine design has an important influence on the effect of service maladjustments on warmup performance, as well as on the performance and sensitivity of the engine in good condition.

A comparison of the effects of the two most important variables - manifold heat and manifold cleanliness - on performance in several makes of engines illustrates the point. For one make, Fig. 3 shows the effect of inoperative manifold heat valve. For another make, Fig. 4 shows the effect a dirty manifold can have. For a third make, Fig. 5 shows the difference between performance with heat off and manifold dirty and with heat normal and manifold clean. In the third engine, not only is the warmup performance better than in the other engines when all are in good condition, but also performance deteriorates less as engine condition deteriorates.

Investigation of effects of other engine operating conditions showed that automatic choke adjustment and accelerator pump stroke setting had no significant effect on warmup characteristics. Radiator covers did not affect initial warmup, but they hastened final warmup in cars that warm up slowly.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)



● Fig. 5 - Overall effect of intake manifold heat and cleanliness on warmup performance of car relatively insensitive to fuel volatility. Car equipped with automatic choke, operated 30,000 miles. Ambient air temperature was 35 F

Motorcycle Engines

DIGEST OF PAPER* BY **William J. Harley** Chief Engineer
Harley-Davidson Motor Co.

BASIC considerations in designing motorcycles both in the United States and overseas are:

- Light weight, and consequently liberal use of light metal alloys,
- High horsepower to weight ratio,
- Good handling qualities,
- Styling, with emphasis on flash and distinctive appearance,
- Low original cost,
- Gasoline economy, particularly in Europe.

Comparisons of domestic and overseas designs in respect to these points show that British and Continental engineers tend to produce lighter motorcycles for equivalent horsepower, even if durability and riding comfort are sacrificed.

Czechoslovakia and Germany have given most consideration to appearance.

Smaller displacement engines in Great Britain and on the Continent provide economy with relative low first cost.

Most foreign makes use a magneto dynamo which supplies ignition and low tension current for lights and batteries.

Single Cylinder Side Valve Engines are made in 15, 21, 30, and 37 cu in. capacities. Usually conventional in design, in most cases they have built up crankshafts composed of two fly wheels with the crankpin, gear shaft, and sprocket shaft bolted into the flywheels.

Single Cylinder Overhead Valve Engines, in displacements of 15, 21, and 30 cu in., are the most popular type of single cylinder motorcycle engines built abroad. Norton and BSA in England and BMW and NSU in Germany are representative manufacturers of this type. Crankshaft construction follows the pattern described above, and aluminum heads and cylinders are popular. Hairpin valve springs are often used in racing motorcycles, but conventional helicals are found in the standard sport models. The enclosed overhead mechanism is lubricated by oil under pressure.

Single Cylinder Overhead Camshaft Engines, made in 15, 21, and 30 cu in. displacements, are usually racing models, although some are made for the general public. Maximum power is sought. All use bevel gears and shafts for valve mechanisms. In some designs, valves are direct acting and others are driven through rocker arms.

One of the highest unsupercharged engines made, the Norton 30 cu in. with 11 to 1 compression ratio, develops 49 hp at 6700 rpm. Its bmep is a little over 200 psi at 6000 rpm. The company claimed this performance on 80 octane. It has a tuned exhaust system with megaphone to assist output.

Two Cylinder Vertical Twin Engines are becoming increasingly popular and more manufacturers, particularly the British, are adopting this type. Most are overhead valve or overhead camshaft, although there is a version of side valve design.

*Paper "Motorcycle Engine Design" was presented at the SAE Milwaukee Section, April 2, 1948.

Some have builtup crankshafts which are either press fitted or bolted, and others are built with one piece forged crankshafts. Some use hairpin valve springs.

Most of these are about 26 hp at 6000 rpm, and have compression ratios of about 7 to 1. The British Sunbeam and BSA, and the German Triumph and NSU are typical.

Two Cylinder V Twin Side Valve Engines are usually of 45 and 74 cu in. capacities, and is the most popular of American makes, although it is made by a British manufacturer.

The Indian has a built up crankshaft, parts taper fitted and held with a single bolt. The Harley-Davidson has high tension coil and low tension distribution, and each spark plug fires every revolution. Other designs fire only on the power stroke.

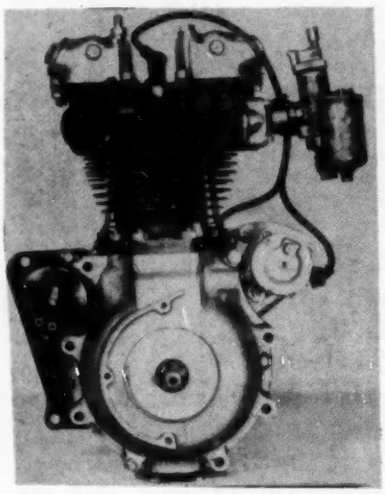
An example of performance of this type, the Harley-Davidson 45 cu in. engine is used for general riding. It develops 25 hp at 4800 rpm with a compression ratio of 6 to 1. This is also used for competition in this country. A 45 cu in. racing engine develops in the neighborhood of 30 to 35 hp at 5500 rpm with a compression ratio of 7.25 to 1.

Two Cylinder V Twin Overhead Valve Engines are made in 61 and 74 cu in. displacements. Harley-Davidson and Vincent HRD, England, make this type.

Harley-Davidsons are made with 45 deg spacing between cylinders, and the Vincent HRD engines are made with 50 deg spacings.

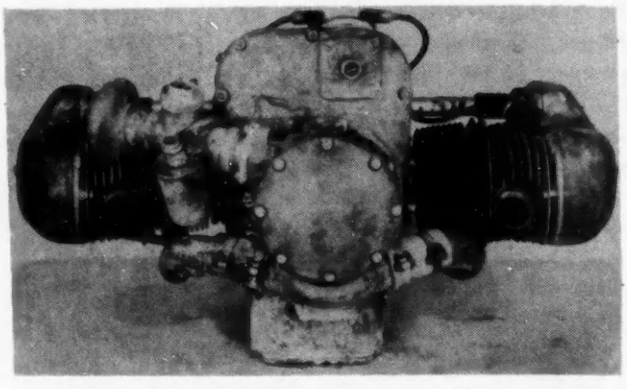
Our crankshaft construction, lubrication system and carburetors are similar to the ones used on our side Valve V twin engines. The valve train is composed of a gear driven camshaft with push rods acting on overhead rocker arms.

Hydraulic lifters are used on the top end of the push rods and oil is fed to them through the rocker arm fingers. This

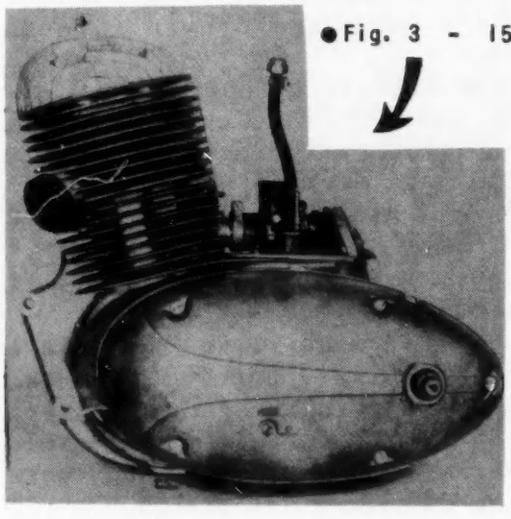


● Fig. 1 - Triumph Tiger 100 Engine

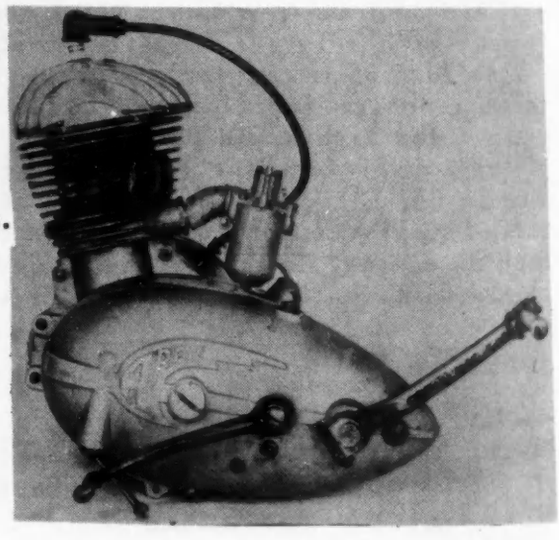
● Fig. 2 - 30-cu-in. BMW Engine



● Fig. 3 - 15-cu-in. JAMA Engine



● Fig. 4 - 8-cu-in. Ardie Engine



oil also lubricates the entire overhead mechanism. Aluminum is used for the crankcases and cylinder heads. Cylinders are nickel cast iron. Our 74 cu in. overhead valve engine develops 47 hp at 4800 rpm with a compression ratio of 7.25 to 1.

Two Cylinder Horizontally Opposed Engines, in 21, 30, and 45 cu in. displacements, have been made in side valve, overhead valve and overhead camshaft construction.

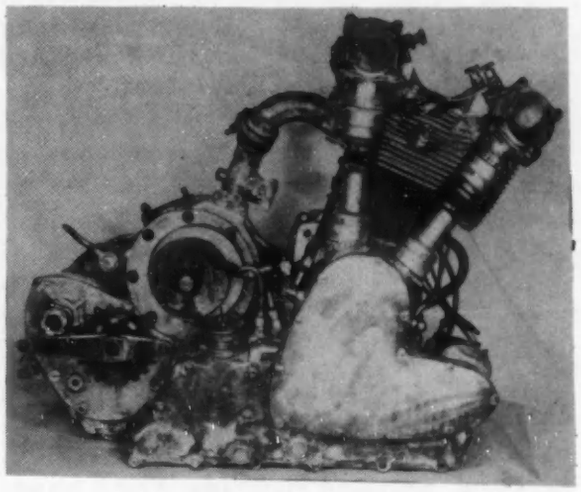
The British Douglas has a 21 cu in. powerplant, develops 20 hp at 6000 rpm with a compression ratio of 6.5 to 1. Prior to the war the German BMW and Zundapp made 35 to 45 cu in. horizontally opposed twin engines.

Novel features of the BMW include builtup crankshafts on the overhead valve and side valve versions. These are composed of two forgings and a center plate. Crank pins are part of the end forgings and press fitted into the center cheek.

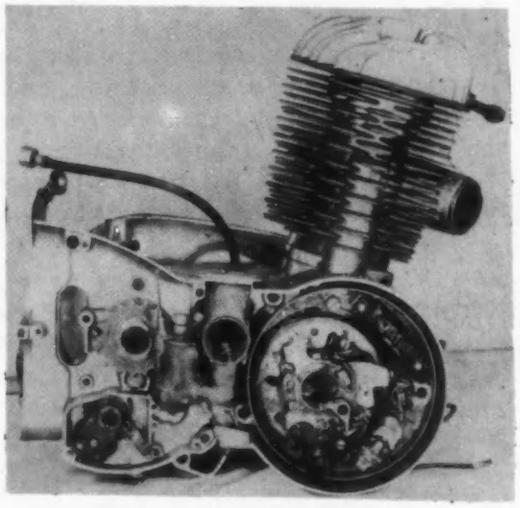
This provides a stiff joint because a proper press fit will resist a surprising amount of torque.

These engines have two carburetors with a common air inlet through an air-cleaner in the bell housing. Lubrication was a wet sump with a low pressure feed to the main bearings.

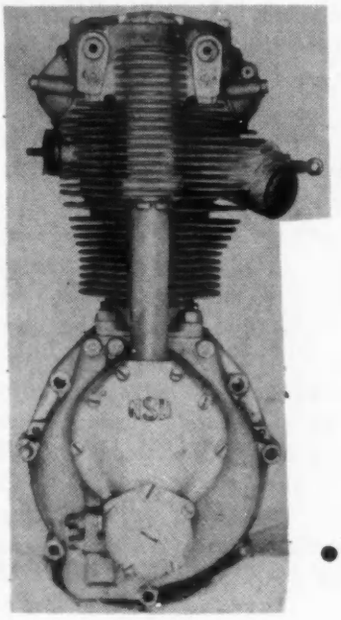
Square Four Overhead Valve Engines are made in 61 cu in. displacement by Ariel of England. It is of the overhead valve push rod type, with two crankshafts geared together, and develops 36 hp at 5800 rpm with a compression ratio of 5.8 to 1. A four-cyl engine, of 45 cu in. displacement, has been made by Zundapp of Germany in the side valve and overhead valve type,



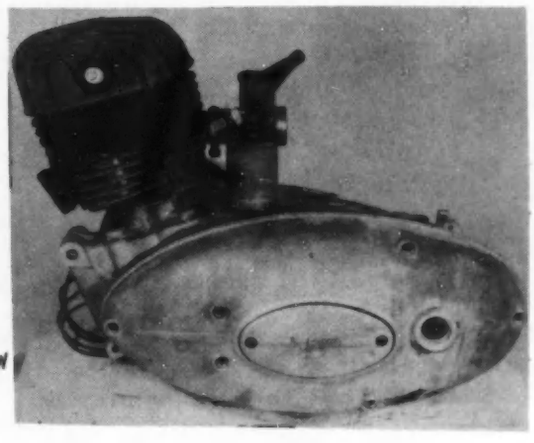
● Fig. 5 - 21-cu-in. NSU Engine



● Fig. 6 - 15-cu-in. Triumph (German)



● Fig. 8 - 30-cu-in. NSU



● Fig. 7 - 15-cu-in. DKW

and was similar in construction to the BMW.

Single Cylinder Two Cycle Engines, of the deflector and loop-scavenged types, are made in 5.9, 7.5 and 15 cu in. displacements. Representative manufacturers are Royal-Enfield and James of England, Jawa of Czechoslovakia, DKW and Ardie of Germany, and Harley-Davidson.

They have aluminum crankcases, cylinder heads, pistons, and in some cases, cylinders.

Rotary valves are used. Engines with flat top pistons and loop-scavenging either use Schnuerle loop-scavenging or some variation.

Typical output of this type is the engine we make for our 125 motorcycle, which develops 3 hp at 4800 rpm with a full stroke compression ratio of 6.6 to 1. Some engines develop more power per cu in., but sacrifice low speed performance and good two-stroking.

Vertical Twin Two Cycle Engines of 30 cu in. was being built by DKW in Germany. Of the crankcase compression type it uses transfer ports and the the Schnuerle loop-Scavenging system. It developed 15 hp at 4000 rpm with an effective compression ratio of 5.8 to 1. That company also manufactured a racing version of this engine in a 15 cu in. size, super charged.

Double Cylinder Common Combustion Chamber Two Cycle engines of about 15 cu in. are built by Triumph of Germany and Ehrlic, British. The former claimed output of 13 hp at 4500 rpm.

The 85 lb Triumph engine is designed with both pistons under one combustion chamber and delivers the power stroke simultaneously. Each of the 7.579 cu in. cylinders have a bore of 1.771 in., and the stroke is 2.081 in.

The mixture, after leaving the carburetor, enters the crankcase area through a gear driven rotary valve in the crankcase. Ignition is supplied by battery, spark coil, condenser, breader points, and sparkplug.

Differing from most two cycle engines, lubricant is supplied from an independent tank to a steel tube cast integral with the clutch cover.

Fuel is supplied to the carburetor and enters the crankcase through the rotary valve.

(Complete paper on which this article is based is available from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

SAE NATIONAL MEETINGS

MEETING	DATE	HOTEL
TRACTOR and DIESEL ENGINE	Sept. 7-9	Schroeder, Milwaukee
AERONAUTIC and AIRCRAFT Engineering Display	Oct. 6-9	Biltmore, Los Angeles
PRODUCTION MEETING and CLINIC	Oct. 21-22	Statler, Cleveland
FUELS and LUBRICANTS	Nov. 4-5	Mayo, Tulsa
	• 1949	
ANNUAL MEETING and Engineering Display	Jan. 10-14	Book-Cadillac, Detroit
PASSENGER CAR, BODY, and PRODUCTION	March 8-10	Book-Cadillac, Detroit
TRANSPORTATION	March 28-30	Statler, Cleveland
AERONAUTIC and AIR TRANSPORT and AIRCRAFT Engineering Display	April 11-13	New Yorker, New York

SAE Participates in IDLEWILD OPENING

General Chairman Harold R. Harris, general manager of American Overseas Airlines and a past vice-president of SAE, opening the program of the International Air Transport luncheon, Aug. 2 at Idlewild. Seated at the extreme left is G. R. McGregor, president of Trans-Canada Air Lines and Sir William P. Hildred, principal speaker

●

MORE than 500 SAE members and guests attended the International Air Transport luncheon, Aug. 2, at New York's new International Airport (Idlewild) on Long Island, sponsored by the SAE Air Transport Activity Committee with the cooperation of the Aircraft Industries Association of America, Air Transport Association of America, American Society of Mechanical Engineers, and the Institute of Aeronautical Sciences.

Ranking management executives and engineers of foreign and domestic airlines and equipment manufacturers heard Sir William P. Hildred, director general of the International Air Transport Association, Montreal, laud the far horizons of American vision which resulted in that vast airport.

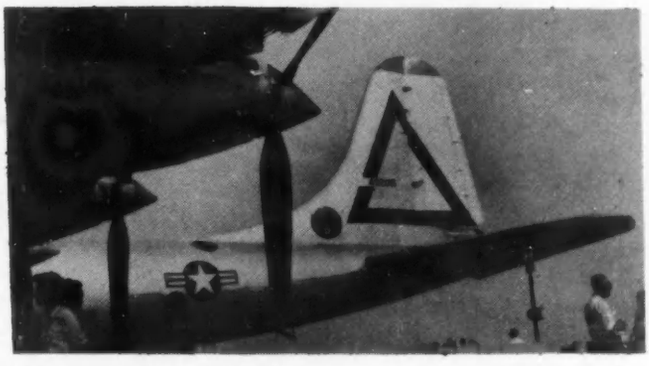
Introduced by SAE Member Vice-Admiral Emory S. Land, USN (ret.), whose facility as toastmaster delighted his audience, Sir William predicted that America will continue to be the dominant factor in world air transport.

New York City was represented by the Honorable James A. Burke, president of the Borough of Queens, and Grover Whalen, chairman of the Mayor's Committee, and the British Government by Sir Francis Evans, consul general in New York.

Following the luncheon most of the audience and guests remained to see a part of the air show in which Army, Navy, British Navy, and the New York Police Department aviators participated.

Vice-Admiral Emory S. Land, toastmaster, who introduced guests at the speakers table, with

Queens Borough President James A. Burke; T. H. Nilert, president, Scandinavian Airlines System; E. G. Bailey, president of the ASTM, and J. H. Carmichael, president of Capital Airlines..... Other guests included SAE President R. J. S. Pigott, Major-Gen. Oliver P. Echols, president of the Aircraft Industries Association of America; John C. Leslie, vice-president of Pan American World Airways System; T. A. Prevost, assistant vice-president of National Airlines; Fernand J. Martens, U. S. manager of Sabena; Henry J. Lesieur, general manager of Air France; S. Paul Johnson, director of IAS; W. L. Pierson, chairman of Trans World Airline; Gordon MacClaren, eastern traffic manager of Northwest Airlines; Radcliff Janas, assistant to the vice-president of Colonial Airlines; Antonio Dugarte, a director on maintenance superintendent of Linea Aeropostal Venesolana, and G. E. Gardner, president of Northeast Airlines



Close-up of two of the six pusher props and tail of the B-36

Mac Short

1897-1948

MAC SHORT, 38th president of SAE, and one of the nation's outstanding aeronautical engineers, died August 13 of a heart attack in the Lockheed Aircraft Corp. plant at Burbank. Calif.

World War I Army pilot officer, barnstormer, instructor at M.I.T., co-founder of Stearman Aircraft Co., founder and president of Vega Aircraft Corp. (later absorbed by Lockheed), his career paralleled the dramatic history of the aeronautical industry to which he contributed much in design and production techniques. He was vice-president of Lockheed in charge of military design and contracts.

Born in Salina, Kans., 51 years ago, he was graduated from Kansas State Agricultural College in 1922 following an interruption of his studies while in the Air Corps of the U. S. Army. He won his masters degree from M.I.T. in 1927. His interest in things mechanical dated to his early years when he helped build a glider, rebuilt used cars and built and raced dirt track racers.

Following the war he was stunt pilot at county fairs which, with racing prize money, helped finance his education. After leaving Kansas State he joined the U. S. Air Mail Service, and later served for a time as aeronautical engineer with U. S. Army at McCook Field, Dayton.

When he helped organize Stearman in 1928 he was elected vice-president in charge of engineering and held that post for the next 10 years. In 1938 he formed AiRover Co., and the next year organized and became president of Vega in Burbank. After three years as administrative head of the company he relinquished those duties to concentrate on design of fast aircraft and bombers.

When Vega was merged with Lockheed he was in charge of a project of designing training planes, and participated in the design and production planning of the Lockheed Ventura and Neptune patrol bombers. Following World War II he was put in charge of the company's military relations.

Active both in technical and administrative affairs, he became vice-chairman of the Aircraft Division of the SAE Standards Committee in 1939, served three terms as chairman of the Kansas City Section, and was elected chairman of the Southern California Section for the 1940-41 term. He was SAE vice-president for aircraft engineering in 1936 and again in 1941, and served as general chairman of the SAE National Aircraft Production Meeting in 1939.

Throughout his career his business and SAE associates found him always thoughtful, understanding and cooperative. His interest in and knowledge of the Society made him one of its most able presidents.

He is survived by his widow Mae Siefkin Short, two daughters, Mrs. Sally Schenck of Richmond, Calif., and Mary, and his son Richard of Glendale.

Chemists Laying Open Diesel Fuel Composition

Based on paper by

HAROLD M. SMITH

Bureau of Mines

(This paper will be printed in full in SAE Quarterly Transactions)

HYDROCARBON make-up of both a straight-run and a catalytically cracked diesel fuel is emerging in investigations using silica gel and distillation separation techniques.

Analysis of data indicates that total paraffin content forms the predominant part of both fuels. It's about 80% of the straight-run fuel, and 61% of the cracked stock. The cracked material seems to have more paraffins in proportion to the naphthene rings than does the straight-run fuel. Though dicyclic naphthenes are believed present, there is yet too little substantiating data.

The cracked stock also contains much more aromatic material than the straight-run fuel. And this aromatic material in the cracked fuel is much more concentrated in terms of aromatic rings than in the straight-run oil. Thus the cracked stock evidences a rather large proportion of bicyclic and tricyclic compounds present - such as naphthalene, methyl and dimethyl naphthalenes, anthracene, and possibly diphenyle.

In gathering data from which these preliminary conclusions were drawn, both oils were treated almost alike. They were first filtered through silica gel to get a paraffin-naphthene portion, an aromatic portion, and a small intermediate portion between these two, largely olefinic material.

Each of the paraffin-naphthene and aromatic portions were then distilled at reduced pressure and small fractions of about 0.5% of the charge taken.

Next various physical properties were determined - particularly density and refractive index, from which many other properties could be calculated. Boiling point also was redetermined at several pressures on some fractions to get a suitable extrapolation of the entire boiling temperature range for all fractions, at reduced to atmospheric pressures. Viscosity determinations, bromine numbers, and ultraviolet adsorption spectrograms also were made on selected fractions to help determine the types of hydrocarbons present.

Certain hydrocarbons are only weakly adsorbed on silica gel, others are strongly adsorbed. This is the basis for separation by this particular method. (Paper "Preliminary Report of Studies on the Composition and Physical Properties of Diesel Fuels," was presented at SAE Annual Meeting, Detroit, Jan. 15, 1948. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Calculations Point Up Diesel Fuel Economy

Based on paper by

WALTER E. TURNER

GMC Truck & Coach Division

CHIEF advantage of the diesel engine is its inherent ability to convert about 50% more energy of a fuel into work than does the gasoline engine. A simple computation will tell you whether the diesel is more economical for a particular operation than the gasoline engine.

Efficiency of present diesel engines is 32 to 38% compared to 22 to 28% for current gasoline engines. (See Table 1.) Thus a diesel engine will yield about 50% greater mileage from a gallon of fuel than a gasoline engine of equal power output. Now suppose we evaluate this in terms of dollars and cents per year to see if it pays to buy the higher-priced diesel rather than a gasoline engine.

Suppose in the state of Ohio you could buy gasoline in tank wagon lots for 19¢ per gal, while diesel fuel cost 14¢ per gal. And let us assume that the gasoline engine vehicle operates at 6 mpg. Our calculations, shown in Fig. 1, would develop as follows:

Dividing the 19¢ by 6 mpg gives 3.1¢ per mile for the gasoline engine. Dividing 14¢ by one and one-half times 6 mpg yields a fuel cost of 1.5¢ per mile for the diesel engine. The difference of 1.6¢ between the two represents savings in fuel cost per mile of the diesel versus the gasoline engine.

Assuming this vehicle operates 50,000 miles per year, annual fuel savings total $805.50.

TABLE 1 - Comparing Engine EFFICIENCIES

Type of Engine	*Efficiency*
Steam	6 to 8%
Gasoline	22 to 28%
Diesel	32 to 38%

If the difference in initial investment between the diesel and gasoline engines is $2000, and we amortize it over a five-year period, cost per year of the additional investment is $400 per year. Thus the total saving - powering the vehicle with a diesel instead of a gasoline engine - is $405.50.

Of course there is more than this quick calculation to determine whether diesel operation is practical. (Paper "How to Select the Proper Truck," was presented at SAE Cincinnati Section, Oct. 27, 1947. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

#1 19 cents divided by 6..... = $.03166

#2 14 cents divided by 9..... = $.01555

#3 .03166 — .01555..... = $.016

#4 50,000

#5 50,000 x $.016..... = $805.50

#6 $2000 divided by 5..... = $400.00

Savings per year in Fuel Cost. = $405.50

Fig. 1 - Cost analysis of diesel versus gasoline engine

Propounds Car Styling Founded on Character

Excerpts from paper by

WILDER HOBSON

Fortune

CHARACTER in automobile styling involves the same basic ingredients as character in any other form of design - honesty and grace.

Let me say that both the Model T Ford and the 320-hp supercharged Duesenberg seem to me to have been cars of stylistic character. And in a very large part for the same aesthetic reason.

Both possessed the first of the two great basic ingredients of character - honesty, candor, explicitness. The little two-seater M.G. sports car, Fig. 1, is a typical example. To many American-trained eyes these lines may seem somewhat old-fashioned. I suppose also that by equipping this same rugged little chassis with a closed, aerodynamic body its smart performance - in the way of acceleration, speed, and gasoline consumption - might even be improved. But this car is a favorite of people who like roofless, out-of-door motoring in the spirit of the M.G. slogan, "Safety Fast."

This car seems to me an almost perfect example of appropriate styling, of a car which looks exactly what it is - a sturdy, wonderfully maneuverable little speedster, shaped for ease and security of handling. In its simplicity and economy of line (everything lean and lithe, no pretentiousness, no excess decorative baggage) it seems to me an eloquent defender of the aesthetic principle of honesty.

While discussing honesty as perhaps the greatest ingredient of style, don't we really admire the awkward honesty of the Model T more than such modern trappings as those wheel discs intended to promote the illusion that the car has white sidewall tires; or those metal station wagon bodies painted to suggest that they are made of wood; or those huge hoods which contain relatively little engine?

If honesty is first, and perhaps the paramount, of the two great character-building ingredients in style, the other is grace. Honesty without grace may be rich without character; grace without honesty surely leaves a bad taste in the sensibilities. But the combination of honesty and grace is well nigh irresistible.

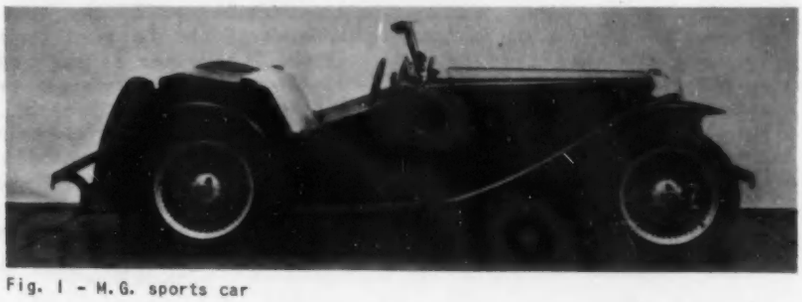


Fig. 1 - M.G. sports car

Fig. 2 - Pinin-Farina body on Alfa-Romeo chassis

Fig. 3 - Italian Cisitalia

The Pinin-Farina body on the Alfa-Romeo chassis, Fig. 2, is a characteristic example of the fluid, subtle school of Italian body design. I think we at once feel the Latin graces of this car; and the longer we consider it, the more our eyes will be delighted by its refinement of line.

I should also like to point out that this body seems to be the work of one man, to be wholly suffused with one designing personality. I don't know whether this is the case. If not, Pinin-Farina has brilliantly concealed the fact. Sinuous personality which this car possesses seems to me wholly remarkable in a world where so many automobile styles - especially American - look like the product not of individual artistry, but of committee work, and pretty vexatious committee work at that.

The aerodynamic logic is so strongly curvaceous that the stylist will have to remind himself, as well as us, that our car does have a mechanical spine. He will have to take honest opportunities to balance his curves with straight lines; and he will have to avoid, wherever it is honestly possible, those extremely opulent curves which render any straight-line influence more or less impotent. If honesty demands the airfoil form, grace demands an expression of straightness, the rigidities that go into the car's structure.

I think the problem is beautifully handled in the little

Cisitalia sports car with a Pinin-Farina body, Fig. 3. Actually there are surprisingly few straight lines in this design; Italian mastery of the curve is plentifully evident. Yet the overall effect is spruce and athletic. I would like especially to call attention to the fastidious way in which the down-flowing slope of the hood has been counterbalanced by the delicate upcurve of the forward fenders. (Paper "Character in the Styling of Automobiles," was presented at SAE Summer Meeting, French Lick, June 7, 1948. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Car Body-Making Art Described Step-By-Step

Based on paper by

WALTER A. GRAF

The Budd Co.

(This paper will be printed in full in SAE Quarterly Transactions)

MANUFACTURE of passenger car bodies - from the stylist's mock-up to assembly of finished stampings - will be detailed in this article in SAE Quarterly Transactions.

In it Graf tells how templates, that define accurately every contour and shape, are made from one-eighth scale models. From there he goes on to the making of plaster models and metal forms, all part of the tool-making process. He points up ideas leading to economical, trouble-free stamping production.

For example, Graf explains the cerrobend frame-checking fixture that eliminates inaccuracies and reduces time required to manufacture forming dies. His discussion of the die design problem, as well as that of other phases of body stamping production, is profusely illustrated. Fig. 1 shows operation of the triple action die, one of the several types described.

The article in SAE Quarterly Transactions also will tell about the preparation and engineering coordination that precedes assembly of all-steel bodies. Design tips are given to the automotive engineer that will yield sound, economical welding. He also is told about other shop equipment and the part they play in joining the parts into the whole. (Paper "Design for Manufacturing Automobile Bodies," was presented at SAE National Passenger Car and Production Meeting, Detroit, March 4, 1948. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

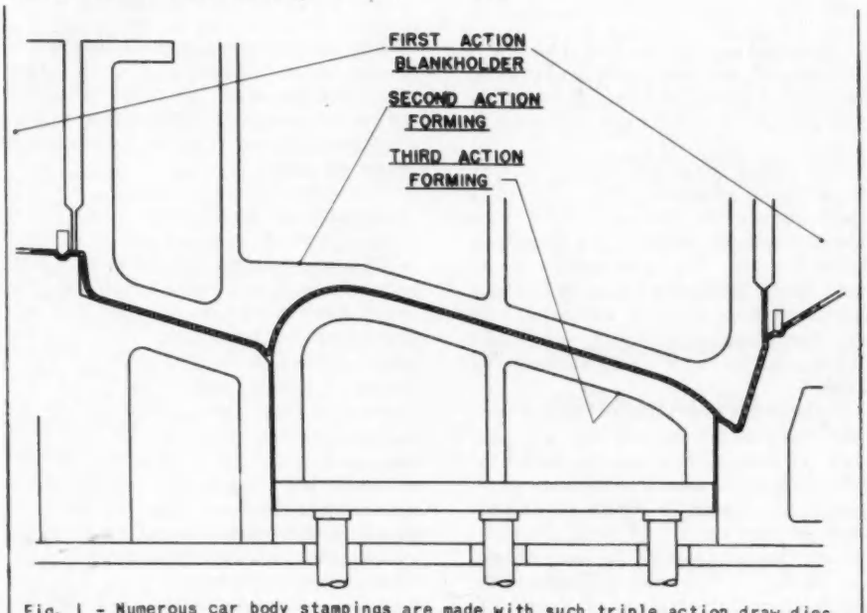


Fig. 1 - Numerous car body stampings are made with such triple action draw dies

Why the Hudson Has a New Look

Excerpts from paper by

FRANK S. SPRING

Hudson Motor Car Co.

FIVE features were aimed for in designing the new Hudson to show improvement over the old car. The new car should:

1. Be lower,
2. Be easier to get in and out of,
3. Have better vision,
4. Handle better, and
5. Give better economy at high speeds.

First three of these items seemed to tie together pretty much as one problem. When we first tried to make the car lower, we decreased the entrance height at the same time. This made getting in and out quite a problem. We finally hit on the scheme of making the frame as wide as the body and lowering the floor so that one could step down into the car. This preserved our usual entrance height.

One can just manage to see the right front fender while driving because of lowered bonnet, cowl crowned at the corner of the windshield, and windshield posts kept well back.

Fourth problem was met by lowering the center of gravity and moving it forward, keeping the same suspension layout of previous models. It has improved both the ride and handling characteristics.

Our attempt to achieve better economy at high speeds led us to the present form of car. Results have been far better than expected. Wind noise at 80 mph is less than it was at 60 mph in our former model. Acceleration at 80 mph is about the same as at 65 mph in the old car. Economy at 80 mph is roughly the same as at 65 mph in the 1947 Hudson.

Top speed of our car is greatly improved. It will cruise easily and quietly at 95 mph with no unpleasant sensation. (Paper "Hudson's New Look," was presented at SAE Summer Meeting, French Lick, June 8, 1948. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Why Valves Stick and Burn

Based on paper by

J. A. NEWTON

Thompson Products, Inc.

VALVE troubles manifest themselves either as unusual temperature conditions or as design shortcomings. Combining proper materials and design will combat valve burning and sticking tendencies.

When properly sealed, a valve will operate at road load conditions indefinitely. Suddenly, because of a peculiar set of conditions, it may operate at greatly increased temperature. This stems from improper sealing at the valve face. Burning is inevitable.

Fig. 1 shows temperature patterns on a valve in normal operation compared with one on which burning has occurred.

Probably most obvious burning cause is blowby at the seat due to insufficient tappet clearance. Their appearance readily identifies valves so burned. See Fig. 2. This failure does not show up as localized burning, but more as a general overheating of the valve head, characterized by gray, nonadherent scale.

Overloading vehicles raises valve temperature above its safe range, causes creep or valve cupping. But if approximate operating temperatures are known in advance, a combination of materials and design generally is available that will hold up.

Worn valve guides also contribute to valve burning. Data collected on aircraft valves showed that increasing valve guide clearance from 0.003 to 0.010 in. will raise valve head surface temperature about 200F. The same trend applies to heavy-duty, sodium-cooled truck valves and, to a lesser degree, in solid valves. The extra clearance slows up valve action, sometimes to the point of sticking. Added clearance allows combustion products to enter the valve guide, combine with oil, which forms heavy deposits on, and carbons up, the stem.

Nonuniform and inadequate cooling causes poor heat transfer through the seat and guide. It also considerably distorts the seat and valve head.

This type of distortion can also be of a mechanical nature. For example, if the valve seat is ground with a pilot seating in a worn valve guide or with a bent pilot, its centerline will be different from that assumed by the valve after installation. In this case there is leakage by the valves immediately after the reconditioning job.

Sticking is ascribed to accumulations on the valve stem and in the valve guide. At high temperatures, oil on the stem oxidizes, decomposes, and deposits coke-like and resinous materials. Dirt and gum from the fuel and lead mix with the varnish and form hard deposits.

First answer to valve burning was hard facing materials. Coating the valve head with nichrome remedies erosion there which weakened the valve and caused hot spots toward the edge of the valve head.

Sodium-cooled valves - now common in heavy-duty commercial applications - reduce operating temperature, increase valve life. Experience also reveals that plain-headed valves resist corrosion more than valve heads with center holes, screw driver slots, and spanner holes. Under certain conditions, such markings may also cause preignition.

Latest development that curbs sticking and burning is the rotating valve. Its advantages are said to be: (1) prevents undue tip wear; (2) keeps valve stems free from deposits; (3) keeps seats clean; (4) prevents hot spots from forming, minimizes tendency for guttering and burning. (Paper "Some Aspects of Valve Burning and Sticking," was presented at SAE National Fuels & Lubricants Meeting, Tulsa, Nov. 7, 1947. This paper is available in full in mulitlithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

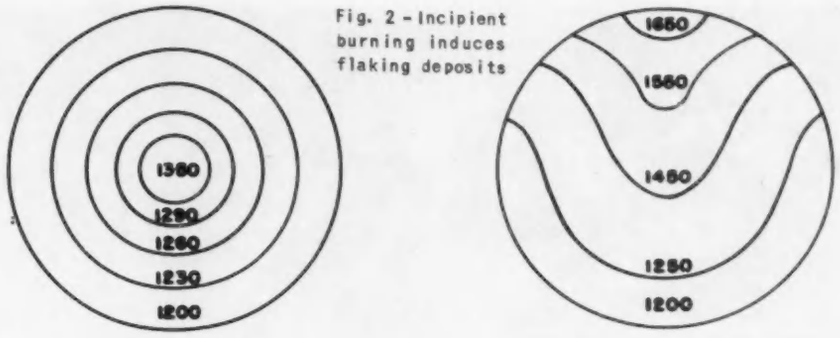


Fig. 2 - Incipient burning induces flaking deposits

VALVE OPERATING TEMPERATURES — °F.

Fig. 1 - Comparison of valve head temperatures under normal operation and with localized burning

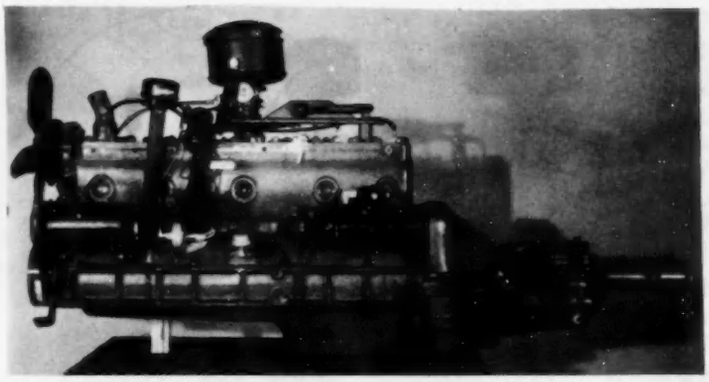


Fig. 1 - Packard's Super eight engine

Parts Interchangeable In Packard Engine Line

Excerpts from paper by

GALE A. SPRAGUE

Packard Motor Car Co.

PACKARD for 1948 continues the 356-cu in. custom eight model engine, redesigned, and adds two new engines - the 327-cu in. super eight and the 288-cu in. Packard eight.

All three engines have the same bore, 3 1/2 in., so that pistons, rings, and many other parts are interchangeable. Because of design detail similarity and because one cylinder block serves two of the engines, another manifest advantage is gained. We are able to change model schedules on our engine assembly line at will, without loss of time and without waiting for block castings or schedule changes at the foundry.

Table 1 lists the major specifications of this engine family. Note that the two new engines have the same AMA horsepower (because of the same bore), the same compression ratio, and almost the same weight. Difference in stroke calls for different crankshaft and connecting rods. The larger engine requires a larger inside diameter intake manifold. Cylinder head combustion volume also differs because of displacement variation. Thus two heads are required to maintain the common 7 to 1 compression ratio.

Only parts not interchangeable in the two new engines are crankshaft, connecting rods, intake manifold, and cylinder head. To this add the vibration damper. The larger Super eight engine has the Packard-designed rubber and friction damper (tuned type); the shorter stroke engine is equipped with the untuned viscous type damper.

Left side of the Super eight engine, Fig. 1, shows mounting arrangement of starter, generator, distributor. The oil pressure sending unit and coil is placed close to spark plugs to allow for shorter and more uniform length of high-tension wires. This also helps suppress ignition system interference with television reception. (Paper "The New Packard Straight Eight Engines," was presented at SAE Summer Meeting, French Lick, June 9, 1948. This paper is available in full in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)

Table 1 - Packard Engine Specifications

	PACKARD EIGHT	SUPER EIGHT	CUSTOM EIGHT
TYPE	L-HEAD-VERTICAL EN BLOC	L-HEAD-VERTICAL EN BLOC	L-HEAD-VERTICAL EN BLOC
AMA HORSEPOWER	39.2	39.2	39.2
BORE	3.500 IN	3.500 IN	3.500 IN
STROKE	3.750 IN	4.250 IN	4.625 IN
DISPLACEMENT	288 CU IN	327 CU IN	356 CU IN
MAX. BHP	130 AT 3600 RPM	145 AT 3600 RPM	160 AT 3600 RPM
MAX. TORQUE (LB-FT)	225 AT 2200 RPM	266 AT 2200 RPM	282 AT 2200 RPM
COMPRESSION RATIO	7 TO 1	7 TO 1	7 TO 1
WEIGHT WITH CLUTCH AND TRANSMISSION	845 LB	849 LB	988 LB

Note Gear-Making Practice For Tractor Transmissions

Based on paper by

WAYNE H. WORTHINGTON

&

BARRETT G. RICH

John Deere Waterloo Tractor Works

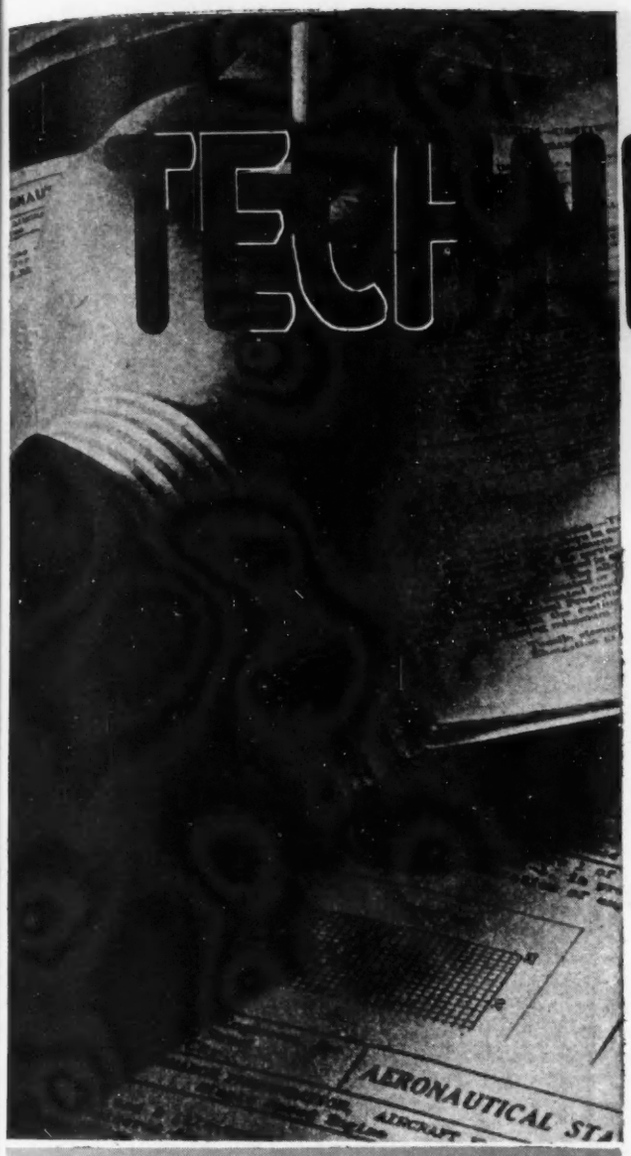
A survey of nine tractor transmission-gearing manufacturers producing 11 different models disclosed the industry is leaning toward alloy steels and toward shaving for final finish.

Alloy steels are used throughout for gearing, it was found, except in five tractors, which used carbon steel for final drive gears. Predominant alloy is the 8600 series, with some 5100 and 4600 series steels also used.

Most transmissions, made from low-carbon steel, are carburized and hardened. Gas carburizing and direct quench seem to be gaining ground. There is also a trend toward local hardening of teeth.

On the machining side, shaving presently predominates as the final-finish method. In four designs all gears are shaved; in four others all except slow-speed gears are shaved. Introduction of this method in the last few years has done much to improve accuracy of gearing.

(This paper, to be printed in full in SAE Quarterly Transactions, also discusses current methods of computing both beam and surface compressive stresses in gears. It's entitled "Current Practice in Tractor Transmission Gears," and was presented at SAE Annual Meeting, Detroit, Jan. 13, 1948. Complete paper is available in multilithographed form from SAE Special Publications Department. Price: 25¢ to members, 50¢ to nonmembers.)



TECHNICAL COMMITTEE PROGRESS

Aim To Make Shot Peening A More Practical Process

Creating a means of getting efficiency and known performance from shot peening, via standards and a shot peening manual, is bringing the Shot Peening Division, of the SAE Iron & Steel Technical Committee, face to face with the indeterminates of this production technique. Shot effect on fatigue life, importance of uniformity, getting uniform screens, correlation between fatigue testing and production performance are but a few of the present impediments to advancement of the art with which the group is coping.

To give the Division a broader base for evaluating effect of various kinds of shot on fatigue life, F. P. Zimmerli, Barnes-Gibson-Raymond Division, Associated Spring Corp., recently presented results he got with such tests on spring wire.

He reported that throughout the range of hardness of the shot tested there was no significant effect on ultimate endurance limit of the springs. And size of shot did not affect endurance limits - within certain limitations. For example, P-16 or P-28 shot gave comparable results. And shot P-46 on 0.148-in. wire lowered endurance limit.

Zimmerli presented data showing practi-

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Harold T. Youngren

At their last meeting at Mishawaka, Ind., members of the Shot Peening Division of the SAE Iron & Steel Technical Committee were guests of American Wheelabrator & Equipment. Sessions were held in the Dodge Mfg. Co.'s conference room. New Division chairman, R. L. Mattson, General Motors Corp., is seated in the first row, third from the right

cally no difference in endurance limits - within hardness limits used - with hard or soft shot. And he found no correlation between arc height and endurance limit. For example, shot peening springs for 15 min with P-16 shot imparted the same endurance limit as shot peening with P-28 shot for 30 min. Arc height with the first lot of springs was 7, with the second, 24.2.

Thus, Zimmerli concluded, arc height of itself means little unless the shot used is specified as to size and hardness. Even then he recommends setting up a minimum arc height by running fatigue tests and trying to get some kind of correlation between arc height and endurance limit for a particular shot.

At the same meeting, J. C. Straub, American Wheelabrator and Equipment Corp., argued for shot uniformity. He particularly stressed the ineffectiveness and production cost penalty of not replacing broken shot. Biggest factor in peening is impact, he said, not arc height. Whole, unbroken shot at slow speeds will produce the same impact as broken shot at higher speed. Whole-shot operation is less costly because of saving in machine wear and tear.

Assume broken shot is removed continuously from a peening machine to get a high percentage of whole shot, said Straub. If now broken shot is replaced with

CONTINUED ON PAGE 91

Technishorts. . . .

TEST CODES: Both the SAE Gasoline Engine Test Code and SAE Diesel Engine Test Code are being consolidated into a single test code for all automotive engines. This new effort will make it possible to publish data on a uniform basis. An important change being made in the test code is the formula for determining corrected brake horsepower; friction horsepower will be taken into account in the revised expression.

AERO SPARK PLUGS: The SAE Ignition Research Committee has appointed a Subcommittee, headed by T. Tognola, Scintilla Magneto Division, Bendix Aviation Corp., to develop a recommended practice for the 3/4-20 spark-plug thread design. It's reported that a thread with these dimensions is easier to manufacture because a thicker shielding can be incorporated in the plug. One engine manufacturer says a more rugged plug with improved structural characteristics, suited for high-altitude, high compression ratio powerplants, can be developed with this thread size.

TRAILER HITCHES: Work is under way to develop a hitch for light trailers to supplement the present SAE trailer hitch standards. Existing SAE trailer hitch standard provides for only two hitches - one for a gross trailer weight of under 5000 lb, the other for a weight over 5000 lb. Both exceed requirements for utility trailers and are not economical for such use.

PROP TOOLING: Standards for tooling to remove and install propellers in sizes No. 70, 80, 90, and 100 are being studied by a panel of the SAE Committee on Standard Components for Aircraft Engines. In taking over the work of the SAE Aircraft Turbine Engine Committee, recently disbanded, this group also is considering developing standards for special turbine-engine tooling. Items being proposed are pusher and puller tools for antifriction bearings, exhaust-cone, lifting slings, and gages for both turbine wheel bucket clearances and compressor blade clearances.

SAE National
AERONAUTIC MEETING & AIRCRAFT ENGINEERING DISPLAY

The Biltmore Hotel
Los Angeles

Oct. 6-9

•WEDNESDAY

INSPECTION TRIP TO MUROC LAKE AIR BASE

•THURSDAY

10:00 a.m. A. L. KLEIN
Chairman

Physiological Aspects of High Speed and High Altitude Flying
-Dr. W. R. Lovelace II, Lovelace Clinic and Trans World Airline.

Aerodynamics of High Speed Airplanes
-K. E. Van Every, Douglas Aircraft Co.

Structural Aspects of High Speed Airplanes
-F.B. Sandgren, Bell Aircraft Co.

(Sponsored by Aircraft Activity)

2:00 p.m. ROBERT INSLEY
Chairman

Problems in the Application of Turbojet Engines in Air Transports
-DimitriusGerdan, Allison Division, General Motors Corp.

The Next Step - Afterburning
-D. J. Jordan, Chance-Vought Aircraft Div., United Aircraft Corp.

(Sponsored by Aircraft Powerplant Activity)

8:00 p.m. W. C. MENTZER
Chairman

Presentation of Manly Memorial Medal to E. F. Pierce and H. W. Welsh by R. F. Gagg, Chairman, Manly Memorial Board of Award.

Effect of the RTCA Program in Obtaining Regularity on Air Operations
-D. W. Rentzel, Administrator, Civil Aeronautics Administration.

Some Economic Problems of the Air Transportation Industry
-W.L. McMillen, American Airlines

Prepared Discussion by W. Hawkins, Lockheed Aircraft Corp.

Economical Aspects of Flying Boat Operations
Captain C. H. Schildhauer, USNR (Ret.)

Over-all prepared discussion by:
-Harold Koontz, Trans World Airline

(Sponsored by Air Transport Acitivity)

• FRIDAY

ALL-DAY PANEL DISCUSSION ON LONG-RANGE OVERSEAS TRANSPORT PLANE OF 1955

W. J. BLANCHARD, Gen. Chairman

10:00 a.m. WILLIAM LITTLEWOOD
Chairman

REQUIREMENTS

PANEL

W. W. Davies, United Air Lines
Charles Froesch, Eastern Air-lines
D. O. Benson, Northwest Airlines
L. R. Koepnick, Trans World Airlines

(Sponsored by Air Transport Activity)

2:00 p.m. A. T. COLWELL
Chairman

POWERPLANTS AND EQUIPMENT

R. E. Johnson, Wright Aeronautical Corp.
L. H. Enos, Curtiss Propeller Division, Curtiss-Wright Corp.
C. M. Christensen, United Air Lines
Warren Boughton, Phaostron Co.

(Sponsored by Aircraft Powerplant Activity)

8:00 p.m. D. R. SHOULTS
Chairman

Presentation of Daniel Guggenheim Medal to Leroy R. Grumman by Grover Loening, Chairman, Daniel Guggenheim Board of Award

COMPLETE DESIGN

PANEL

Harold Adams, Douglas Aircraft Co.
R. L. Bayless, Consolidated Vultee Aircraft Corp.
H. D. Hoekstra, Civil Aeronautics Administration
C. L. Johnson, Lockheed Aircraft Co.
George Tharratt, Douglas Aircraft Co.

(Sponsored by Aircraft Activity)

•SATURDAY

10:00 a.m. B. J. VIERLING
Chairman

Powerplant Problems,
-G.W. Newton, Boeing Aircraft Co.

Flight Qualities and Performance
-Melvin Gough, National Advisory Committee for Aeronautics

System Functioning
-Rudy Thoren, Lockheed Aircraft Corp.

Prepared discussion by:
-George Haldeman, Civil Aeronautics Administration
-F. W. Fink, Consolidated Vultee Aircraft Co.

7:30 p.m.
BANQUET AND GRAND BALL

New SAE Section Chairmen

NEIGHBOURS
. . . .of Baltimore

Harold D. Neighbours speaks with authority when it comes to putting the brakes on. As a partner in Air Brakes & Controls Co. of Baltimore, he helps keep scores of trucks and buses in top stopping condition.

He traces his entry into the automotive accessory business back to 1920 when he went to work for the Magneto & Machine Co., now Parks & Hull Automotive Corp., as electrical shop foreman. In those days, he avers, ignition systems and generators were as tempermental as prima donnas and often weighed as much. However, he had a good grasp of early day electrical apparatus, having completed electrical courses at the Bliss Electrical School and done electrical contracting work after his discharge from the Coast Artillery following World War I.

In 1933 he applied his accessory sales and practical experience to introducing air brakes, as southeastern manager for Bendix-Westinghouse Automotive Air Brake Co.

Stationed in Atlanta, Harold promoted the cause of air braking, installed new systems and instructed drivers and mechanics until 1937. That year he opened a Washington, D.C. office for Bendix-Westinghouse and performed early defense work for the Motor Transport Section of the Quartermaster Corps, and later the Ordnance Department.

In 1942, Harold left the Bendix-Westinghouse organization and with W.L. Shirley, established Air Brakes & Controls.

Born in Frederick, Md., Harold still likes the atmosphere of small towns and the country, after work in bustling industrial Baltimore. For this reason he lives out of town on the Magothy River, where he keeps his bird dogs and goes fox hunting.

After attending SAE meetings for years, Harold joined the SAE in 1943 and plunged into Baltimore Section activities.

--John D. Waugh, Field Editor

LONG
of Metropolitan

Fate manhandled Metropolitan Section's new chairman when he nodded "yes" to a beckon from the automotive industry back in 1918, because deep in his heart Richard C. Long has pronounced nostalgia for the Iron Horse, its firebox, drivers, throttle, whistle, and snorting disposition.

Part and parcel of the annual SAE pilgrimage to French Lick Springs as far as he is concerned are the torturous grades in the Grafton, West Virginia, area, the curves swinging around the bends of the Cumberland River, and the struggle of steam over gravity between Clarksburg and Keyser deep in the Cumberland mountains.

Under these circumstances Dick lets himself go and, wallowing in recollections of his earlier railroading up in New England, automotive equipment is forgotten.

Native of North Walpole, N. H., he worked four years in Chestnut Hill, Mass., for an automotive concern before joining Wheels, Inc., where his enthusiasm and energy won him the post of vice-president and sales manager of the New York automotive distributing organization.

He helped convert local truck fleets from solid to pneumatic tires, was in the midst of the changeover to balloon tires for automobiles, and became an expert on vacuum brakes. He resigned from Wheels Inc. in 1942 to become Eastern representative of the Warner Electric Brake Mfg. Co. of Beloit, Wis., with offices in the General Motors building in New York.

His service to Met Section has been marked by the same energy as has been his business career. Active in membership work for several years, he successively served as Reception Chairman, was elected Treasurer two terms, and has just finished his term as Vice-Chairman. While treasurer he reorganized the Section's budget setup and accounting and made it a model in the opinion of accountants.

During these years of SAE activities he has helped his fellow Governing Board members with his seasoned advice, and frequently stepped up to the plate to do some needed pinch-hitting when called upon. He joined the SAE in 1932. - A. B. Saxman, Field Editor.

PAUL
. .of Philadelphia

Born on a farm in New Jersey, Parry Paul felt the urge to go west for an education and enrolled in The University of Wisconsin. While studying there to be a mechanical engineer he first became interested in the Society of Automotive Engineers, and joined as a Junior Member.

At graduation he enlisted in the Motor Transport Corps, U. S. Army, World War I, and was stationed at Camp Holabird, Md.

Following the war, the spirit of adventure took him to the Volga valley, in Russia, where he had charge of the tractor program of the Quaker relief, which was affiliated with the American Relief Administration under Herbert Hoover. This was at the time when America was helping to relieve starvation in Russia.

Returning to the States, Paul joined the International Motor Co. (Mack Trucks) at the Plainfield, N. J. Division.

His enthusiasm for the automotive field continued through the years and brought him to his present association with Autocar, of Ardmore, Pa.

In between these connections, Paul was associated with the Philadelphia Rural Transit Company, which operated the buses in Philadelphia and some of the suburban territory, under Mitten management. His work there had to do with inaugurating a preventive maintenance and rebuilding program.

From boyhood Parry's hobby has been automobiles, and now he gets keen enjoyment in attending the meets of the Antique Automobile Club of America, of which he is a member. He says it is just a coincidence that the first car he ever rode in as a boy was an Autocar.

He is married and has a son who enjoys accompanying his dad to see how cars looked in the early days, when you cranked them by hand and had acetylene headlights with the old carbide generator.

SAE NATIONAL PRODUCTION MEETING and CLINIC

STATLER HOTEL
Cleveland, Ohio

Oct. 21-22

THURSDAY

2:00 p.m.

E. F. GIBIAN, Chairman

The Application of Quality Control to the Automotive Industry
-J. N. Berrettoni, Dr. J. N. Berrettoni & Associates

The Antioch Process and Its Relation to the Foundry
-E. A. Canning, Allison-Bedford Foundry, Allison Division, General Motors Corp.

6:00 p.m. Buffet Supper

8:00 p.m.

JOSEPH GESCHELIN, Chairman

The Manufacture of the Dynaflow Transmission
-F. C. Pyper and A. G. MacDougall, Buick Motor Division, General Motors Corp.

FRIDAY

10:00 a.m. - 2:00 p.m. - 3:30 p.m.

ALL-DAY PRODUCTION CLINIC

Panel discussions not available.

R. F. STEENECK, Chairman

Seven separate informal gatherings to exchange information and experience on vital production problems. Each group will have a panel of experts available all day to answer questions. Come early; quiz the experts; and go home with the answers.

1. DIE CASTINGS AND PLATING PROBLEMS

-R. D. Beatty, Jr., President, Manor Die Casting Corp., Panel Leader.

2. GEARS

-V. C. Speece, Executive Truck Engineer, White Motor Co., Panel Leader.

3. INSPECTION AND QUALITY CONTROL

-W. S. Howard, Chief Inspector, White Motor Co., Panel Leader.

4. METALLURGY AND HEAT TREATMENT

-H. B. Osborn Jr., Sales Manager, Ohio Crankshaft Co., Panel Leader.

5. PRODUCTION AND MANUFACTURING CONTROL

-S. F. Stewart, Executive Vice-President, Leece Neville Co., Panel Leader.

6. WELDING

-K. W. Schreeck, Test & Exper. Engineer, Towmotor Corp., Panel Leader.

7. MATERIAL HANDLING

-K. R. Weise, Chief Engineer, Tramrail Division, Cleveland Crane and Engineering Co., Panel Leader.

6:00 p.m. . . . . DINNER

About S

PAUL G. HOFFMAN, Economic Cooperation Administrator and trustee and former student of the University of Chicago, will be the principal speaker at the fiftieth anniversary celebration of the School of Business at the university on September 2.

P. W. LITCHFIELD, chairman of the board, Goodyear Tire & Rubber Co., and president of its Peruvian subsidiary, has been awarded the Order of the Sun, with grade of Knight Commander by Peru's minister of foreign affairs. He received this in recognition of his contribution to the economic welfare of Peru, through the establishment five years ago of a Goodyear tire factory there.

JOHN L. COLLYER, president of B. F. Goodrich Co., has been named national chairman of the greater Cornell Fund and will lead a two-year campaign for $12,500,000 to meet immediate needs of the university.

ROGER M. KYES has joined the staff of General Motors, Corp., and will work on special assignments, reporting directly to C. E. WILSON, president. Kyes was formerly president and general manager of Harry Ferguson, Inc.

HERBERT C. WENDT, body engineer, Overseas Operations, General Motors Corp. has received his second James F. Lincoln Arc Welding Foundation award. He received $3200 for a paper written by him and awarded first place in the automotive classification of the $200,000 Design-For-Progress Program.

R. C. LOOMIS is now director of flying at Consolidated Vultee Aircraft Corp., San Diego. He moved from Kansas City, where he had been Trans World Airlines' director of maintenance and overhaul, several weeks ago. Nominee for SAE Air Transport Vice President for next year, Loomis is currently a member of the Air Transport Activity Meetings Committee.

JOSEPH GESCHELIN, SAE past vice-president and Detroit editor, Automotive Industries, will prepare a paper for the Congress International Des Fabrications Mecaniques, in September. The topic will be "Postwar Developments in Manufacturing Techniques".

WALTER A. OLEN, president of the Four Wheel Drive Auto Co. has announced that the Four Wheel Drive Foundation has been incorporated under a Wisconsin law for charitable, educational scientific, and literary work.

SYDNEY G. TILDEN, JR., has been appointed project engineer of Permafuse Corp., Brooklyn, N. Y., upon his graduation in business and engineering administration from M.I.T., S. G. TILDEN, president of the thermo plastic brake lining company announced.

GEORGE A. GREEN is in Paris as assistant director, Industry Division, Economic Cooperation Administration. His job: "to deal with the industrial requirements of all the countries operating under the Marshall Plan." . . . Col. Green previously had a good chance to study European production as co-leader of the Wier-Green mission during World War II. Subsequently, he made a complete survey for the Liberia Co. (headed by Edward Stettinius) of natural resources in Liberia. He has been intensely active throughout the period since his retirement as vice-president of engineering, GMC Truck & Coach, several years ago.

SAE Members

A. M. FLEMING has been appointed vice-president in charge of manufacturing of the Chrysler Division of the Chrysler Corp. This was a promotion from the position of general works manager that he had held for the last 11 years. Fleming joined Chrysler in 1924, the year that the Chrysler car was introduced. FRED A. WUNDERLICH succeeds him.

H. WILLIAM OVERMAN has entered into the manufacturing of materials handling and brake servicing equipment as part owner and director of sales and engineering of the Unit Mfg. Co., Columbus, Ohio. He was formerly manager of Industrial Friction Materials and Industrial Wheels Divisions of the Thermoid Co., Trenton, N. J.

F. R. BANKS, technical manager, Associated Ethyl Co., Ltd., presented the first Louis Bleriot Lecture to the French Association of Aeronautical Engineers and technicians (A.F.I.T.A.) in Paris last May. His talk, entitled "The Art of the Aviation Engine," discussed the necessary organizational and technical planning to maintain aggressive aircraft powerplant development.

K. M. WATSON, formerly with the Oahu Railway & Land Co., has become superintendent of maintenance of the Oahu Transport Co., Ltd. in Honolulu, T. H.

EDWARD A. HALBLEIB has retired as general manager of Delco Appliance Division, General Motors Corp. at Rochester, N. Y., after nearly 40 years of association with the division and its predecessors in Rochester.

C. C. HARWOOD, who had been branch manager for the Sun Electric Corp. in Seattle, Wash., has been transferred and is now acting as zone manager for this company in Detroit.

AL VOS of Kansas City, Mo., has been appointed manager of the Detroit office of the Yald & Towne Mfg. Co. to handle the sale of Yale automotive locks and specialty hardware to manufacturers in Michigan.

JOSEPH GILBERT, technical editor of the SAE Journal, was one of a group of 15 business paper editors that recently toured the Oak Ridge plant facilities through the courtesy of the U. S. Atomic Energy Commission. This group was one of the first given a guided trip through the entire Oak Ridge Reservation.

JOHN E. HACKER, former works manager of the Cleveland Diesel Division of General Motors Corp., past vice-president of SAE and former chairman of the Cleveland Section, has been appointed assistant works manager of Electro-Motive Division of the corporation. Before taking up duties at LaGrange, Ill., Hacker will set up the new Plant 3 of the Division in Brooklyn, Ohio.

PAUL H. WILKINSON has just published the 1948 edition of "Aircraft Engines of the World." It features complete specifications of 31 jet engines and gas turbines, including some that the Russians have copied from advanced German designs. The reciprocating engines section gives complete specifications for 106 powerplants, including two new Argentine engines and several Russian copies of American and French powerplants. Particulars and weights of fuels and lubricants used in American and British reciprocating and jet engines are given in tabular form.

PETER F. ROSSMANN, formerly assistant to the president of Curtiss-Wright Corp., has been elected president of the Symington-Gould Corp. His headquarters will be at Depew, N. Y., where the general offices of the corporation are now located.

JOHN H. MATTHEWS, vice-president and director of Raybestos-Manhattan, Inc., Passaic, N.J., was elected to the board of directors of the Canadian Raybestos Co., Ltd. on May 20. The Canadian company makes automotive friction material and rubber and asbestos products for the Canadian market and is an operating unit of Raybestos-Manhattan, Inc. Matthews joined Raybestos-Manhattan in 1914 and is now in charge of the Manhattan Rubber Division at Passaic.

GILBERT K. BROWER, formerly assistant director of research at American Airlines, Inc., LaGuardia Field, has been elected vice-president of manufacturing for the John L. Ray Oil Co. in South Braintree, Mass.

WALTER J. KISH recently became production manager of Merriman Mfg. Co., Wichita, Kans.

ROBERT J. SCHROERS has become affiliated with the Civil Aeronautics Administration in Washington, D. C.

PAUL D. METZLER, development engineer, Pontiac Motor Division of General Motors Corp., Pontiac, Mich., had been an instructor in mechanical engineering at the University of Michigan, Ann Arbor.

JOHN E. ROWE is now plant manager of the Ross Operating Valve Co. in Detroit.

TIMOTHY M. LAWLER, JR., previously assistant dynamometer engineer with the Nash Kelvinator Corp. in Kenosha, Wis., has now become project engineer in the Experimental Department of this company.

HEYLIGER CHURCH, vice-president in charge of sales at the Weatherhead Co., has been advanced to executive head of all sales divisions of the company.

E. B. NEWILL, general manager of the Allison Division of General Motors, has been elected a vice-president of General Motors Corp. He joined this company in 1929.

WILLIAM M. HAWKINS, JR. has become a research engineer with the American Car & Foundry Co. in New York City. He was formerly associated with the Packard Motor Car Co. in Toledo, Ohio.

JAMES L. GREGG is now professor of metallurgy at Cornell University, Ithaca, N. Y. Prior to this post he was assistant to the vice-president at the Bethlehem Steel Co. in Bethlehem, Pa.

RAYMOND F. CHRISTOPHER recently became vice-president in charge of sales for the Sun Electric Corp., Chicago, Ill., after having served as regional sales manager for this company.

WILLIAM R. RECTOR, previously an installation engineer for Pratt & Whitney Aircraft, Division of United Aircraft Corp., East Hartford, Conn., has now become aerodynamics engineer, Consolidated Vultee Aircraft Corp., Fort Worth, Tex.

GEORGE H. NEUGEBAUER, now an engineer with the Arma Corp. in Brooklyn, N. Y., had been assistant professor in machine design at the Newark College of Engineering, Newark, N. J.

FRED HEDEMANN has been made superintendent of operations for the Oahu Transport Co., Ltd. in Honolulu, T. H. He is publicity chairman for the SAE Hawaii Section.

HAROLD H. HUNT, until recently general manager of the Corcoran Implement Co., Corcoran, Calif., has now become vice-president and general manager of Scarborough-Hunt, Inc. in Merced, Calif.

TERRY M. PRUDDEN recently named design engineer for Aerojet Engineering Corp., Aeusa, Calif., had been connected with Menasco Mfg. Co. in Burbank, Calif.

RICHARD F. WINCKEL, recently graduated from A & M College of Texas, College Station, Tex., is a junior engineer with the Texas-Eastern Transmission Corp. in Shrevesport, La.

LOUIS E. BARNES is now engineering designer for North American Aviation, Inc., Los Angeles. Prior to this position he was with Barnes & Hopkins, Pasadena, Calif.

ROBERT DONALD HIGH, recently became sales engineer with the Newark Pulley Co. in Newark, N.J. He was formerly assistant chief engineer at Associated Managers, Inc. in New York City.

GUY F. MORRIS has become co-owner of McCarthy & Morris Construction Co., who specialize in excavating, grading and earth moving. They are located in Peoria, Ill. Morris was previously with the Caterpillar Tractor Co. in Peoria, Ill.

BENJAMIN BREWSTER has been appointed to the newly-created position of manager of the Technical Service Division of the Ethyl Corp. Research Laboratories in Detroit. This division is the liaison group between the Ethyl Laboratories and oil company research departments, and automotive and farm equipment manufacturers. Brewster joined Ethyl Corp. more than 21 years ago as a member of the automotive engineering staff.

EDWARD J. HOCK has been appointed supervisory planner and estimating engineer of the entire aircraft powerplant material requirements research, applicable to all turbo jet and conventional type engines, at the U. S. Naval Air Station, Alameda, Calif. He was formerly aircraft engine accessories planner and estimator.

EVAN S. PRICHARD is now sales manager of the Western Ford Motor Coach Sales Co. in Seattle, Wash. Prior to this post, he was chief engineer, Tricoach Co., Inc., same city.

FREDERICK C. REED has become a design engineer with Curtiss-Wright Corp. in Columbus, Ohio. He had been affiliated with Link Aviation Corp., Binghamton, N. Y.

W. J. PARDUCCI recently became chief draftsman of the Campini Turbine & Jet Division of the Tucker Corp. in Chicago, Ill. He had previously been designer with Packard Motor Car Co., Toledo, Ohio.

WALTER TREFZ, until recently connected with the National Standard Parts Association in Chicago, is general manager of the Southwestern Warehouse Distributors, Inc. in Dallas, Tex.

Recently graduated from Purdue University at West Lafayette, Ind., ROBERT F. HERRICK has become assistant plant engineer of the Chesebrough Mfg. Co. in Perth Amboy, N. J.

CARL W. SPRING, who is a former field editor and vice-chairman for Fuels & Lubricants of the Northern California Section, has retired after 22 years with the Shell Oil Co. in San Francisco.

REED M. SYLER, manufacturers sales representative for the U.S. Rubber Co. in Chicago, had been field engineer for this company in Detroit.

FRANK J. HART, who had been manager of Towne Motors, Linden, N. J., has become president of Lloyd's Motors, Inc. in New York City.

A. G. ELLIOTT has been elected a member of the council of the Royal Aeronautical Society. He is chief engineer of Rolls-Royce, Ltd.

Heretofore supervisor of diesel power for the American Locomotive Co. in Schenectady, N.Y., TIMOTHY H. MURPHY has become vice-president and treasurer of Geo. A. Holder & Co., located in Lynchburg, Va.

RICHARD M. ADAMS, formerly production control superintendent of the Atlantic Division of Pan American Airways, Inc., has been transferred to Miami, Fla., where he is in charge of production control for the Latin American Division. The air line has taken over the former U. S. Army Miami Air Depot, and those and new facilities will total about 30 acres under roof. Adams recently resigned as Metropolitan Section vice-chairman for Air Transport.

R. KENNETH WINKLEBLACK is now associate scientist (engineer) at the Argonne National Laboratory in Chicago, Ill. He was previously application engineer for Lear, Inc. in Grand Rapids, Mich.

PERCY W. HAWTIN, recently made service representative for the Twin Coach of Canada, Ltd., Toronto, Ont., had been connected with West Vancouver Municipal Transportation, Hollyburn, B. C.

FRANK NOGAR, JR., recently associated with the Continental Aviation & Engineering Corp., Detroit, is now associated with the Kaiser Frazier Corp. same city.

OBITUARIES

GEORGE C. COLLINS

George C. ("Chet") Collins, fleet sales manager for the Service Division of Thompson Products, Inc., Cleveland died suddenly in Columbus, Ohio, on August 14. He was on a business trip for his company, accompanied by his wife, Gladys. He was 51 years old.

Collins was widely known in the replacement parts industry as an authority on maintenance and repair operations for heavy-duty trucks and buses. He joined Thompson Products in 1929.

EARL D. SIRRINE

Earl D. Sirrine, who served in the Autocar Factory organization as Sales Engineer from Feb. 1, 1930 to Sept. 30, 1944, died July 25, at Marianna, Fla., where he had gone to the home of relatives after leaving a hospital. Failing health was a reason for his retirement from the Autocar, but his condition was not then considered to be serious and he responded satisfactorily to the relaxation of his new home in Port Orange. He was 61.

Commonly known in the industry as "Ed", he was a colorful personality, and generally popular. He had in a pronounced way the characteristics and speech patterns of the 'old American' stock, quirks of phrase and of view point that derived from a time when life in America was simpler, more intensely individualistic and had more time for exchanging cracker-barrel comments on men and events. He had a rather remarkable mind in which he had gathered, without much formality of acquisition, all sorts of facts and proficiencies.

Ed used to be in general charge

One of the strongest selling statements that can be made regarding any engine-powered equipment is this:

"It's Powered with a FORD-BUILT ENGINE!"

Engines available through district sales offices of Ford Motor Company or through Ford Dealers. Universal Ford Service always available everywhere.

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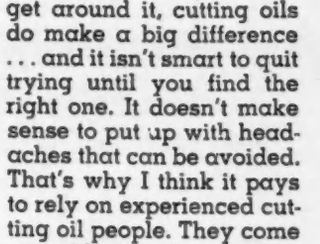
"Good Cutting Oils Sure Keep You Out of Trouble"

...says "CHIP" WRIGHT

"Whenever there's trouble with tools or finishes or jobs fall behind schedule, the first thing I check is the cutting fluid, because when that's not exactly right, it's surprising how it can upset the whole job. You just can't get around it, cutting oils do make a big difference ... and it isn't smart to quit trying until you find the right one. It doesn't make sense to put up with headaches that can be avoided. That's why I think it pays to rely on experienced cutting oil people. They come up with sound, practical assistance."



Here's a Practical Tip:

For Your *Toughest* Jobs Try THREDKUT

You've heard of THREDKUT and what it has accomplished on tough jobs where other oils have failed. The stabilized balance between its uniformly high anti-weld value and its other desirable cutting characteristics, make it especially efficient in the machining of tough, stringy metals ... and for the more difficult operations such as thread cutting, tapping, broaching and gear shaping. Here's a cutting fluid that can help you. For complete information, write for the THREDKUT Booklet.

Another Time-Tested Stuart Product

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of preparing the material in the Sales Manual, and he handled that work with such pronounced individuality that it was occasionally difficult for both the Engineering and Advertising Departments, who shared his responsibility, to know in advance what was going to appear in print.

One time, working all by himself, he designed a new heavy-duty dump model, and published complete specifications for it. Those pages were quickly extinguished as soon as Branches began to send in inquiries regarding the new model. Some years after that incident, a man then prominent in the Engineering Department said the model Ed designed was a good one, but practical reasons had made it impossible to add it to the line.

Sirrine was born in Oil City, Pa. In his boyhood he saw and learned much about the petroleum industry. In his young manhood he had a varied and adventurous experience running a foundry with his father in a primitive region of Arkansas.

He was for several years a member of the engineering staff of the White Motor Co. before joining Autocar. Since his retirement in 1944 he had been periodically engaged in advising the sales and service policies of various Autocar dealers in Florida.

S. W. RUSHMORE

Samuel W. Rushmore, one of the industry's most colorful inventors, died Aug. 16 in his home in Plainfield, N. J. He was 77.

Before reaching the age of 21 he was superintendent of transportation for the New York Electric Street Railway, one of the earliest systems in the United States, and before the turn of the century had held responsible management posts in Chicago, Cleveland, New Orleans, and Pittsburgh.

At an early age he invented a horizontal carbon electric searchlight which was used by the Navy, railroads, and interurban lines. The Army ordered 1,000,000 shells he invented during World War I, and his manufacturing and real estate operations made him a millionnaire at the age of 43.

His mansion on a hill was one of the show places of Plainfield. He considered his library the most extensive private collection of books, magazine, and other historical documents in the field of automotive engineering, and he estimated that he also had more than 10,000 volumes and other items on electrical engineering.

During his earlier days as an SAE member he took delight in vigorous discussions at technical meetings and other veteran members will recall with nostalgia his often used closing quip: "History will prove that Rushmore is right." He often was, according to the record of events.

He devoted his later years to development work in his laboratory and machine shop on his estate. He is perhaps best known among many for his inventions and development work on steam cooling systems for automobiles, and is said to have had more than 80 patents on these devices alone.

EVERETT E. RICHMOND

Everett E. Richmond, who joined SAE in 1915, died in his home in Wanamassa, N. J. July 31. He was 64.

An electrical engineer who had a wide experience in automotive engineering as tool designer with Locomobile in Bridgeport, and as production executive for several companies including speed boats and submarines while with Elco and in charge of a munitions factory during World War I, Richmond retired 10 years ago and had developed a number of devices in his home workshop.

Born in Norwich, Conn., he attended Norwich Academy. He was chief engineer of Elco and was superintendent of that concern's gun factory where the Davis anti recoil weapon was manufactured primarily for aircraft.

ROBERT K. SPANGENBERG

While on military leave with the U.S. Air Forces as reserve captain Robert K. Spangenberg was killed July 15 in a superfortress crash near Smoky Hill Airfield, Salina, Kans. He was 30.

Upon his graduation from Case Institute of Technology in 1940, he joined the Ethyl Corp. research laboratories in Detroit as a project engineer.

During the war he served in the Army Air Force overseas with the 36th Fighter Squadron in England.

He had been active in the organization of the Detroit Section Junior Group, and was a member of the Section's reception committee.

CONTINUED FROM PAGE 82

material with a wide size range, then the smaller sizes of new shot will be removed from the machine together with broken shot, without actually having been used in the peening operation.

Form Aero Standards For Accessory Units

AIRCRAFT engine advances are influencing changes in engine-mounted accessories, as witnessed by efforts in SAE standards work on accessory drives and flanges. Cases in point are accessory envelopes for turbine engines, remote gear box input drives, quick attach-detach mountings, and platform mountings.

Turbine powerplants have matured to the point where standards are needed for accessory envelopes (outline drawings giving external dimensions)

Because demands on accessories, especially those for commercial transports, are becoming increasingly greater, the units are growing to the point where they are too big to be mounted on the engine directly. For this reason they are being driven by a remote gear box input drive. The Committee plans to prepare standards for these drives. It also feels that the shaft and engine drive unit should be standardized too, since the entire remote drive mechanism is really an integral unit.

Large alternators, generators, and starters also have given rise to platform mounting methods to provide greater rigidity for the installation and to dampen vibrations. Standards for this type of mounting are being considered by the Committee.

The conferees also plan to complete an aeronautical recommended practice for quick attach-detach mountings, which has been hanging fire for over a year now. Because development of these units is still progressing, the group is delaying action on standardization of the device itself.

As a temporary measure, it plans to prepare a performance standard to allow a variety of designs to be included. Preliminary proposals for such a standard include vibration and strength requirements, time limits on installation and removal of a free unit, and exclusion of special tooling.

Talk of uniformity carried through to discussions of a standard for screen mesh openings. Shot peening users find screens of the same size, produced by different manufacturers, vary because of difference in wire size. Weavers of sieve cloth for precision sieves draw their own wire. Selection of wire diameter is one of individual preference of these manufacturers.

One way of achieving mesh uniformity in any desired size is by an electrolytic etching process. Material used is copper, which is then nickel plated.

Another problem in peening is the correlation of shot fatigue tests with performance in production machines. N. S. Mosher, Chevrolet Motor Division, GMC, pointed out that a test machine may show steel shot to be 50 times better than iron shot. But in production, peening machines may show the steel shot to be only fivetimes better. He doesn't know what causes this difference. It may be grit, hardness of the target, or loss or leakage.

One Division member believes that the only worthwhile test is determination of shot breakdown rate in a test machine compared to that in a peening machine.

The Division hopes to bring together laboratory results with production experience ina fatigue testing procedure both for peening shot and cleaning shot. It is not yet known whether one or two procedures will be necessary.

Present SAE cleaning and peening shot specifications are no longer considered to be adequate. Because the Division feels the present cleaning shot specifications are broader than need be, a new specification is being prepared. It also has been recommended that the peening shot standard be dropped from the SAE Handbook because it no longer is useful. This matter is being submitted to a letter ballot vote.

To crystallize good practice in the shot peening field, the Committee has set as its goal an SAE Shot Peening Manual. According to preliminary plans, the manual will describe different kinds of peening machines and equipment, different types of shot, and how shot and equipment will be used and on what parts.

At the last meeting, the Division accepted with regret the resignation of Chairman J. O. Almen. His successor is R. L. Mattson, General Motors Corp. New member of the group is J. H. Clark, International Harvester Co.

Silicone News

DC SILICONES

IN BLIZZARD OR HEAT-WAVE . . .

Fortunately for men and machinery, blizzards come in season. We have time to prepare for them with heavier clothes and thinner lubricants. But it is not practical to change lubricants in aircraft that take off in tropical heat and fly into sub-zero weather, or in the parking meters that line the main streets of cities and hamlets from the Yukon to the Rio Grande.

Photo Courtesy Mi-Co Meter Division, Michaels Art Bronze Co.

Dow Corning Silicone Oil, DC 550R lubricates 8 moving parts and enables Mi-Co parking meters to give trouble-free service the year around.

The problem in such cases is to find a lubricant which does not run out when hot, thicken when cold, or gum up with age. That's why many manufacturers like the Mi-Co Meter Division of the Michaels Art Bronze Co. Inc., of Covington, Kentucky, are using DC Silicone Oils or Greases.

Mi-Co Meter required a lubricant that would not thicken or thin out enough to alter the performance of parking meters exposed to temperatures ranging from −40° to 150° F. Field testing under the sun of California and in the blizzards of Fairbanks, Alaska proved that one of our silicone oils, DC 550R, was superior to any other lubricant tested. Now all Mi-Co Meters are factory lubricated with DC 550R.

Dow Corning Silicone Oils and Greases are used in a wide variety of applications from automatic toaster timers to 6 inch roller bearings exposed to temperatures up to 700° F. If your lubrication problems involve high or low temperatures, weathering, or a combination of all three, phone our nearest branch office or write for data sheet C5-9D on DC Silicone Oils or data sheet D1-D on DC Silicone Greases.

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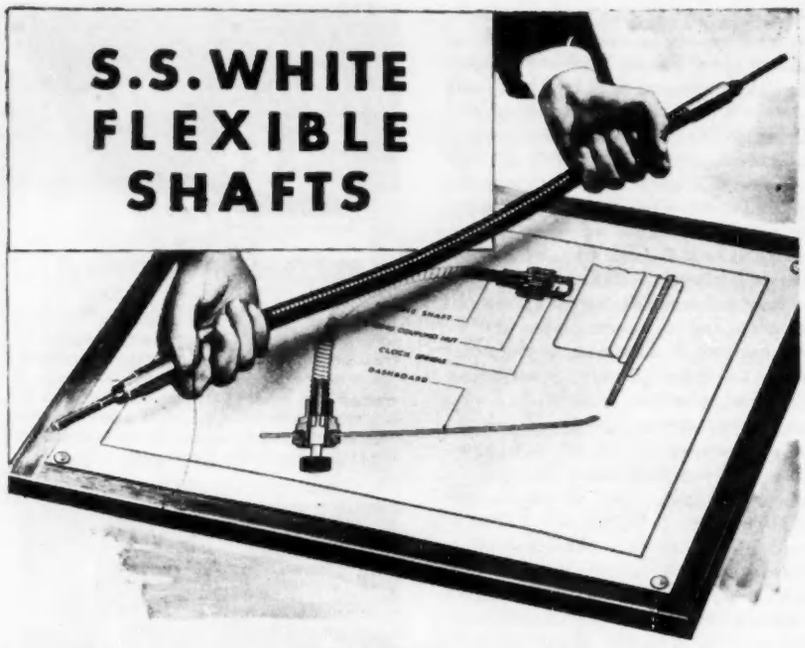

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You'll Be Interested To Know...

WICHITA SECTION has added a vice-chairman representing Fuels & Lubricants Activity; CHICAGO SECTION, a vice-chairman representing Engineering Materials and Production Activities.

TUESDAY, NOV. 16 has been established as the date for the 1948 Beecroft Memorial Lecture. Washington Section is host. Lecturer is Thomas H. McDonald, Commissioner, Public Roads Administration. (See SAE Journal, March, 1948, p.63.) Pyke Johnson, chairman of the Beecroft Award Committee, will be toastmaster.

R.J.S. PIGOTT, president of SAE, has been made an honorary member of Associazione Tecnica dell'Automobile of Italy.

AMERICAN SOCIETY FOR METALS plans to present "Distinguished Service Awards" to individuals who have made outstanding contributions to the development, application, and progress of alloy steels. The presentations will be part of a "Salute to Alloy Steels" at the 30th Annual Metal Congress and Exposition in Philadelphia. . . . SAE members are invited to nominate men who, in their judgment, have contributed most to advancement of alloy steels in the automotive industry. . . .Nominations should be sent to J. M. Schlendorf, Republic Steel Corp., Republic Building, Cleveland 1, Ohio. Mr. Schlendorf is chairman of the committee of judges which will make the awards.

"FORTUNE", in its August, 1948 issue, carries a full-length feature article about SAE. The story was written by Wilder Hobson of the Fortune staff who attended the Summer Meeting at French Lick and presented a paper on "Character in Styling of Automobiles."

Student Branch News

THE SAE Student Branch at Northrop Aeronautical Institute is continuing its technical and social activities through the summer. On July 14 Herman I. Stiglemeier, past-president of Southern California Soaring Association and holder of soaring's highest international award, outlined the history of soaring to the Branch.

He predicted that the glider may serve in the future for high-altitude and weather research.

The Branch opened the Institute's summer social season with a most successful dance at the Hermosa Biltmore's Blue Room. Fifteen lucky NAI men were escorts of TWA stewardesses, who were guests of the Branch.

Altogether, more than 200 members and guests danced to the music of a four-piece orchestra and witnessed charades during the intermission.

Lloyd Toberg as the starving student and W.G. Smith as the man with the subsistence checks had VA officials turning over in their filing cabinets.

Nick Stasinos teamed with Adolph Avondo and R. L. Martin to pantomime an instructor checking student drawings. Avondo came back later to mimic a lunch-time Lindberg flying his brand new control-line model airplane.

Coming Events

Central Illinois - Sept. 27
Jefferson Hotel, Peoria, Ill.; dinner 7:30 p.m. Meeting 7:45 p.m. Automobile Designs, Present and Future - Joseph Geschelin, Detroit Editor, Chilton Co.

Chicago - Sept. 24
Westward Ho Golf Club; dinner 6:00 p.m. Annual Playday and Golf tournament (golf, dinner, prizes, entertainment). Tournament begins at 1:00 p.m. Special features to be announced later.

South Bend Division - Sept. 15
LaSalle Hotel, South Bend, Ind.; dinner 6:45 p.m. Meeting 8:00 p.m. Fuel Injection - John Marshall, Bendix Products Division, Bendix Aviation Corp.

Cincinnati - Sept. 27
Bradford Machine Tool Co.; dinner 6:30 p.m. Plant visitation meeting to be held at Bradford Machine Tool Co., 657 Evans St., Cincinnati 27, Ohio.

Spokane-Intermountain - Sept. 17
Desert Hotel; dinner 7:00 p.m. Engine Tune up on Chassis Dynamometer - J. F. Conner, Auto Inter-

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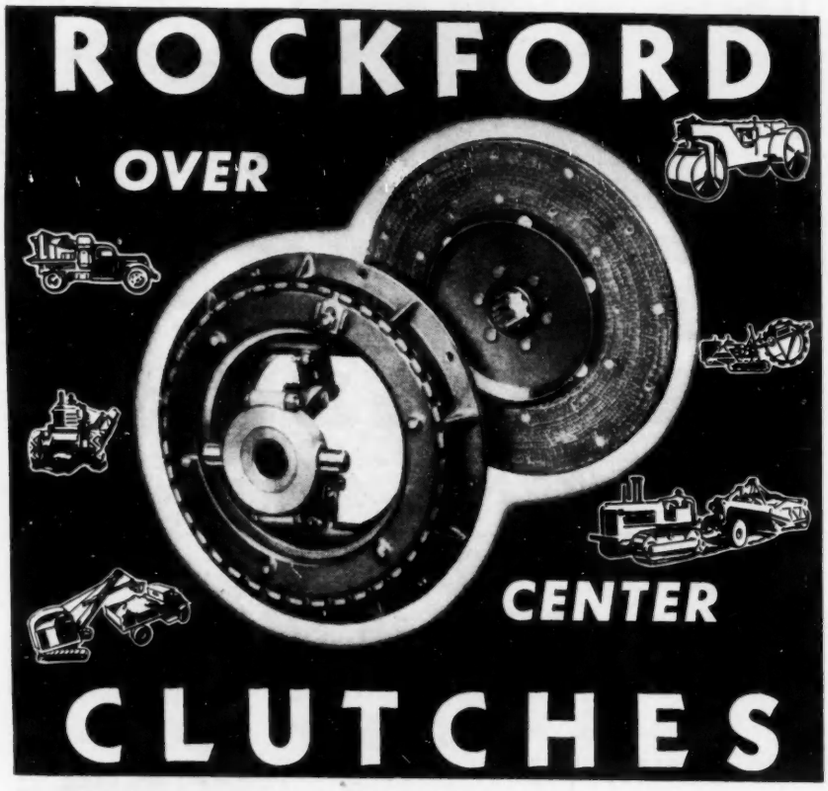
urban Co., Spokane, Wash. Film by Lou Johnson, Colyear Motor Sales, Spokane, Wash.

Twin City - Sept. 2
Curtis Hotel, Minneapolis, Minn.; dinner 6:30 p.m. Quality Control and Engineering Specifications - Dr. J. N. Berrettoni.

Virginia - Oct. 11
Country Club of Virginia, Richmond, Va.; dinner 7:00 p.m. Subject to be announced.

Williamsport Group - Sept. 13
The Anglers Club; dinner 6:45 p.m. Current Motor Car Design Trends - Joseph Geschelin, Detroit Editor of Automotive Industries. On display - A group of plastic models showing the major stages in the building of the Hudson car, from frame to finished assembly and a full sized cutaway model of the Buick Dynaflow assembly.

Colorado Group - Sept. 29
Time and place to be announced. Developments in Fuels, Lubricants and Lubrication - R. J. S. Pigott, chief engineer, Gulf Research and Development Corp., and president, SAE.



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New Members Qualified

These applicants qualified for admission to the Society between July 10, 1948 and Aug. 10, 1948. Grades of membership are: (M) Member; (A) Associates; (J) Junior; (Aff.) Affiliates; (SM) Service Members (FM) Foreign Member.

British Columbia Group: Walter Bailey Deaville (A).

Canadian Section: John L. Housley (A), Richard David Margesson (A), Harvey James Patterson (A), Lynne Everett Windsor (M).

Chicago Section: Jack E. Gutridge (M), Ray W. Harrow (M), Stanley McFarlane (A).

Cleveland Section: Elmer Anderson (M), Thomas P. Christen, Jr. (J), Willard H. de Bruin (M), William H. Robbins (J).

Detroit Section: Kurt B. Boehm (J), Ben F. Bregi (M), Marcel Francois DeMuller (A), John F. Halbeisen (A), Charles E. Hubbard (A), Alexander B. Katovich (A), Gregory Kraus (M), Robert Haaren Maguire (M), R. L. McKinney (A), Albert C. Russell (A), Donnell A. Sullivan (M), H. Luther Wagner (M), Robert Lauren Wiltse (J).

Hawaii Section: Philip Beverly Brown (A).

Metropolitan Section: James B. Barnhart (A), Paul E. Friend (J), Martin E. Karp (J), John Mikulak (M), Charles Mitchell Parker (M).

Mid-Continent Section: Donald William Frison (A).

Milwaukee Section: William Anthony Grambo (J), Edward A. Hunt (M), Ralph N. Kircher (M).

Northern California Section: Herman H. Mesick (A).

Philadelphia Section: John R. Bates (M), Toshiyuki Fukushima (J), David H. Kaplan (J).

Pittsburgh Section: Hiland G. Batcheller (M), Jeff Coats (A).

St. Louis Section: Albert Alvin Hazell (A).

Southern California Section: Merle H. Blick (A), William A. DeRidder (A), Berry W. Foster (J), William K. Knepp (A), Marion Sloan McKellar (M).

Syracuse Section: Pierre M. Hulsart, Jr. (M), Charles F. McElwain (A).

Twin City Section: William Fenton Miller (M).

Western Michigan Section: Charles Wm. Frick (M).

Wichita Section: Louis D. Nelson (J), J. C. Wilson, Jr. (J).

Outside of Section Territory: D. Ned Brown (A), Capt. Rolland Francis Fetters (A), Thomas J. Hoskins (A), Harold E. Johnson (SM).

Foreign: Reginald John Excell (FM), England; Robert William Robinson (FM), So. Amer.; Daniel Norman Walker (FM), England; John Williams (FM), England.

Applications Received

The applications for membership received between July 10, 1948, and Aug. 10, 1948 are listed below.

Baltimore Section: Laurance Sanford Haynes, Jr.

British Columbia Group: Clement Edward Barnsdale, Edward Walter Higgins.

Canadian Section: Eric Trelawny Batchelor, Ray W. Johnansen, Brenton Wilbert MacKeen, George E. Mason.

Chicago Section: Walter Miller Buben, Waldemar J. Distler, Harold A. Doolittle, Leonard R. Fergin, J. L. Hipple, Arnold E. W. Johnson, Clyde Paul Kolthoff, Jr., Willian Joseph Orr, Roy Willian Roush, Jr., Anthony A. Russ, Howard B. Zimmerman.

Cincinnati Section: Thomas Felton Cowley, George J. Hust, Frederick Michael, Tangutari Narashimha Rao, William Bailey Schenell.

Cleveland Section: John W. Cochrun, Dan W. Holmes, Harry Franklin Hostetler, David S. Vaughan, Daniel E. Votypka.

Colorado Group: Norman B. Spitzer.

Detroit Section: Edward S. Agni, Conrad F. Bennett, F. L. Bird, James Robert Burns, William John Coughlin, Owen C. Creteau, Joseph Arthur Egan, Leonard J. Evans, John Einar Filippi, Roger T.

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Gaskill, George I. E. Hansen, Robert J. Kasurin, George A. Kozloff, Harvey H. L. Mantey, Mocherla Kanaka Raju, Richard Neil Sheilds, Robert R. Svenson, Harvey C. Swift, Ahmed S. Zaki, Norman P. Zierk.

Hawaii Section: Harvey Harakawa.

Indiana Section: Richard L. Cassman, Robert William Heid, Jr., Charles E. Kincaid, D. J. Schrum.

Kansas City Section: George W. Forman.

Metropolitan Section: Wilbur Melvin Crook, Lindsay Dunham, Jr., Geoffrey W. Fuchs, George Walter Gmitter, Bernice Harris, Irving J. Mack, Edward Stanly Miller, James P. Murray, Charles E. Stevens, Jr., Sydney Gwyer Tilden, Jr., Adolph J. Weigand, Frances L. Weeden, Henry Scherp Weston, Donald Eli Witkin.

Mid-Continent Section: Hugh V. Byler, Jr., Paul E. Griffith.

Milwaukee Section: John M. Gerty, George John Heberer.

Mohawk-Hudson Group: Edward W. Light, Sr.

New England Section: James Stuart Walker.

Northern California Section: Thomas L. Craig, Tore Nelson Franzen, William E. Kelley, Ervin R. Lehr.

Northwest Section: David James Busch.

Philadelphia Section: Jules Braunstein, Charles S. Gilbert, Jr., Edwin P. Walsh.

Pittsburgh Section: Albert Pryibil McCauley, Jr., David Grider Woodward.

St. Louis Section: Brian Edward Boyle.

Salt Lake City Section: William D. Osborne.

Southern California Section: William Henry Foland, Harry Glascock, Joseph E. McGinty, Calvin E. Porcher, Bill C. von Esch.

Southern New England Section: Henry M. Horn, Morgan Jones, Jack Rodin, Donald Hart Vetterlein.

Syracuse Section: Robert J. Miller.

Washington Section: Lt.-Col. John Howard Cunningham, Willian H. Wiegering.

Outside of Section Territory: Arthur Anthony Aymar, H. F. Bloodworth, James W. Chambers, James Grimley Duffy, Jr., Alfred E. Fitch, Jr., William W. Higbee, Edgar R. Jordan, James Carrol Key, Robert C. Kreite, Victor Arthur Wegner.

Foreign: Alfred Elias Beaver, Jr., India; Charles Henry Budge, England; Andre Cattin, France; Fikret Celtikci, Turkey; Raymond Earl Christian, India; Oswald Anthony Hardy, India; Martin E. Holt, India; Walter Russell Jepson, India; Jean Lemarie, France; David Olof Johannes Lindgren, Sweden; Harbans Lall Puri, England, K. E. W. Ridler, England; Bernard Harry Riley, France.

CONTINUED ON PAGE 98

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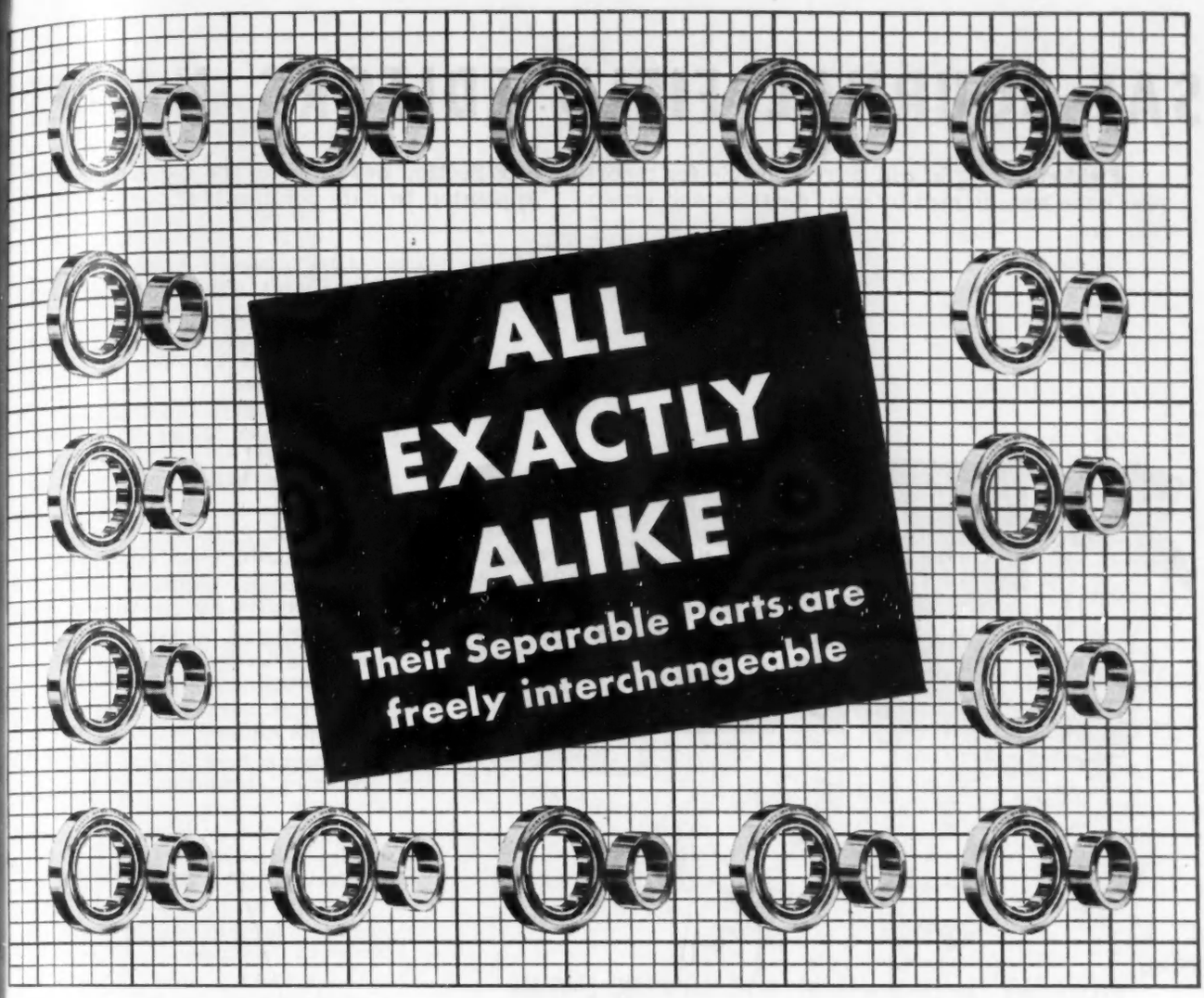

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SAE JOURNAL FIELD EDITORS NAMED

Field editors who will be responsible for reporting SAE Section news during the coming Section year have been named by most Sections and Groups. Appointed to date for the 1948-1949 Section year are:

John D. Waugh, Aeromatic Propeller Department, Koppers Co., Inc., Baltimore;

R. L. Smirl, assistant chief engineer, Borg & Beck Division, Borg-Warner Corp., Chicago;

Harold B. Frye, Chief engineer, K-D Lamp Division, Noma Electric Corp., Cincinnati;

Wilson B. Fiske, White Motor Co., Cleveland;

James E. P. Sullivan, Airtemp Division, Chrysler Corp., Dayton;

William F. Sherman, Automobile Manufacturers Association, Detroit;

Rene Guillou, professor of agricultural engineering, University of Hawaii, Hawaii;

Albert B. Saxman, associate editor, American Automobile, Metropolitan;

William F. Ford, head of mechanical laboratory, Continental Oil Co., Mid-Continent;

Arnold Okuro, professor of automotive engineering, Franklin Technical Institute, New England

Fred G. Wildhagen, transportation engineer, International Harvester Co., Northern California;

Dan P. Chaney, editor, Motor Transport, Northwest;

Ernest L. Korb, director of petroleum chemicals laboratory, E. I. du-Pont de Nemours & Co., Inc., Philadelphia;

Murray Fahnestock, editor, Ford Field magazine, Pittsburgh;

Albert D. Trager, Mack Mfg. Co., St. Louis;

Alexander M. Watson, field service representative, United Aircraft Service Corp., Southern New England;

Floyd Patras, manager of maintenance, Southwestern Gray Hound Lines, Inc., Texas;

Jean Y. Ray, manager motor vehicle department, Virginia Electric & Power Co., Virginia;

Jesse T. Duck, automotive engineer, National Bureau of Standards, Washington, D. C.;

Herman F. Stapel, Pump Engine Division, Continental Motors Corp., Western Michigan;

John B. Tompkins, editor, Westrade Publications, British Columbia;

Robert G. Shanklin, Socony-Vacuum Oil Co., Inc., Mohawk-Hudson, and

Horace W. Epler, Lycoming Division, Avco Mfg. Corp., Williamsport.

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